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A Vision for the Virgin: Conservationist Approaches to River Management

Southern Utah Wilderness Alliance
1471 South 1100 East
Salt Lake City, Utah 84105
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September 1993

NATIONAL PARK SERVICE
WATER RESOURCES DIVISION
FORT COLLINS, COLORADO
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...even the weariest river
Winds somewhere safe to sea.

--Algernon Charles Swinburne
The Garden of Prosperine

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INTRODUCTION

The Virgin River, which originates in Southern Utah's high plateaus, flows through Zion National Park in Utah, passes through the scenic Strip region of extreme northwest Arizona, and eventually empties into Nevada's Lake Mead. The Virgin is one of the last rivers in the West still retaining the bulk of its natural, free-flowing character.

Because of its rather rare status--and because of the way it has been utilized throughout the years--the Virgin can be viewed as an endangered being of sorts. The history of Virgin River management has been one of unbalanced use, where agricultural and, more recently, domestic needs reign supreme. At the same time, its natural values--its wildlife and wildlife habitat, its riparian vegetation, its scenic splendor--remain all but ignored. The historic lack of balance is continued today when one considers which uses receive the most attention and financial support from planning entities, or when one thinks of which resources absorb the brunt of the harmful impacts resulting from development on the Virgin. In almost all cases, *instream resources* receive minimal management emphasis, protection and funding.

However, recent attention to the Virgin's other resources has revealed emerging interest in the public values of the river--the rich and diverse wildlife, the numerous habitat-providing riparian areas, and the opportunities for aesthetic and recreational experience. There is a great deal of public concern about the future of the Virgin. There is clearly a need, then, to create a balance in Virgin River management, and to protect the river's natural regime to the extent that it remains. This report is offered as a "blueprint" for a process to restore that balance.

The first step in that process requires revised management approaches. The notion that humans should develop the Virgin for their purposes must be replaced with the understanding that the river supports numerous other values and, at those times when human actions and the needs of the natural system conflict, the former will not always be granted precedence.

It is also important to protect the Virgin from being pulled apart by competing, uncooperative, and often, simply uninformed users. An inter-disciplinary or inter-jurisdictional approach to managing and protecting the river is notoriously absent.

Decisionmakers tend to approach the river from only one angle, which focuses on managing the river for human consumption. Existing plans for the river's short-term future do not envision any appreciable change in that approach, so the Virgin can only become more unbalanced. As there is no indication that the current planning regime will change, we have undertaken the challenge to offer several management approaches that depart from the *status quo*, and that will better ensure protection of all the Virgin's values.

Therefore, we offer SUWA's vision of what steps are needed to reverse present trends and to return the Virgin River to the status of one that can attend to the needs of all its dependents.

Overview Of This Report

A Vision for the Virgin contains seven chapters. Chapter I includes a discussion of the Virgin River basin's history and geography. It is notable that many issues at stake in the earliest years of Virgin River management have yet to be resolved--foremost among them being the issues of whether or not the Virgin River basin can support a viable agricultural economy and/or a large-scale human population while ensuring protection of the region's other resources.

Chapter II provides an overview of the river's current status. Of particular importance here are the analyses of the various demands now in place on the Virgin, how these demands are met, and what institutions are present to ensure demands are met in the future. Of particular importance among these demands are the needs of instream resources. Historic human domination of the river's waters has, in the minds of traditional water managers, reduced the needs of native fish and other resources to, at best, a secondary consideration. The recognition of instream resources' rightful claims to sufficient water must be restored if the Virgin is to be managed successfully.

An examination of the traditions in place regarding current Virgin River management practices forms Chapter III. Much of the river's mismanagement can be traced back to traditions and attitudes that, despite their wastefulness and self-contradictory nature, continue to exist.

Chapter IV outlines and discusses in detail the threats now endangering the Virgin. Given the current population growth rates in the basin's communities, the development atmosphere evident throughout the region, and the general institutional disdain for the protection of instream uses, there exists a very real possibility that the goal of engendering balance in the Virgin will become even more unattainable as the various water development projects proposed for the basin move forward.

Chapter V departs from the outmoded practices currently the norm and analyzes a number of responses available to conservationists wishing to protect the various riverine resources still surviving on the Virgin. Chapter VI is an extension of this issue, and focuses on additional, long-range management alternatives that hold out promise for protecting the Virgin and its dependent resources. Some of these alternatives involve only minimal changes to water management methods, while others would require significant reforms in such areas as water pricing, jurisdictional matters, and so on.

Chapter VII then provides a conservationists' blueprint--in the form of specific management prescriptions--for the Virgin River. Finally, the Appendices contain the maps and other figures referred to throughout the text.

Chapter I

The Virgin River Basin

A River In The Desert

The Virgin River flows for some 200 miles through portions of Utah, Arizona, and Nevada, the three most arid states in the country, emptying a basin of 5900 square miles. Over the span of its journey, the Virgin occupies elevations as low as 2600 feet and as high as 11,300 feet. Anyone with the good fortune to somehow float the river from end to end would surely be amazed at the incredible array of delights within and alongside its length: the deep, narrow canyons of Zion National Park and the Virgin River Gorge; the robust riparian zones bordering the many tributaries and springs in Utah and Arizona; the populations of rare bird, amphibian and fish species scattered throughout all three states; and, finally, the excellent opportunities for solitude and recreation available in the Beaver Dam Mountains Wilderness and at Lake Mead National Recreation Area. Traveling the entirety of the Virgin allows us to better understand the critical role it serves in sustaining the wide range of resources in its basin.

Utah Segment

The Virgin's two major headwater streams, East Fork and North Fork, each arise on the east side of Utah's Zion National Park, located on Southern Utah's Markagunt and Paunsaugunt plateaus. The East Fork originates in Kane County near the town of Alton, and passes through the southern part of the park. A significant portion of the East Fork's route includes Parunuweap Canyon, currently slated for wilderness designation by both conservationists and the Bureau of Land Management. Parunuweap, first explored by John Wesley Powell in 1872, is a favorite area for hikers, due to its wealth of unusual landforms, colorful wildflowers, hanging gardens, and archeological treasures.[1]

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[1] Powell's journal entry of September 10, 1870, notes, "The Indian name of [this] canyon is Paru'nuweap, or Roaring Water Canyon. Between the little river and the foot of the [canyon] walls is a dense growth of willows, vines, and wild rosebushes...[i]t is not a wide stream--only 20 or 30 feet across in most places; shallow, but very swift." Powell, (continued...)

The North Fork, a perennial stream, grows out of the several smaller creeks, including Goose Creek, Kolob Creek and others, that run through various canyons on the Horse Pasture Plateau in Zion. Like its sister, the North Fork provides access to another of Zion's world-class hiking trails--"The Narrows."

After flowing past the park's headquarters area, the North Fork joins the East Fork just south of Springdale, Utah, where the river then begins to track to the west-southwest. The waterway roughly parallels Utah State Highway 9 as it flows past the small town of Virgin. There, it breaks away from the highway and meanders south, passes in deeply incised canyons through the Hurricane Cliffs between LaVerkin and Hurricane, and then begins another dive to the south just east of the Quail Creek dam and reservoir.

As the Virgin enters the rapidly growing St. George area, much of its flow is diverted as it passes a complex of canal works, including the Washington Fields diversion, the St. George/Washington Canal, and the Bloomington Canal. Eventually, the river, now running with substantially less volume in a wide, sandy channel, crosses under Interstate Highway 15 and ventures out again onto public land until it reaches the Beaver Dam Mountains region, the Virgin River Gorge (where it often disappears below ground), and the Utah state line.

Throughout its course, it should be noted, a number of significant tributaries flow into the Virgin from the north: the Santa Clara River, Ash Creek, LaVerkin Creek, and North Creek. Water from several other streams--Fort Pearce Wash, as well as the Mill, Deep, South, Orderville, and Goose creeks--also makes its way into the mainstem.

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[1](...continued)
John Wesley. The Exploration of the Colorado River and its Canyons. Dover Publications: New York (1961) [at 293].

BLM has recommended 17,888 acres for wilderness designation in Parunuweap; the Utah Wilderness Coalition's proposal calls for 37,700 acres. Utah Wilderness Coalition. Wilderness at the Edge: A Citizen Proposal to Protect Utah's Canyons and Deserts. Foundation for the Utah Wilderness Coalition: Salt Lake City (1990) [at 109].

Arizona and Nevada Segments

The Virgin emerges at the end of the Gorge, leaving behind the Colorado Plateau and the Mohave Desert to enter the Sonoran Desert in a region of northwest Arizona referred to as the "Strip." Its flow is amplified via several spring discharges, particularly at Beaver Dam Wash. Arizona's portion of the river runs through lands generally free of human development, except for some minor agriculture in the Littlefield area. As a result of its virtually untouched nature, the entire length of the Virgin through the Strip has been recommended for inclusion in the federal Wild and Scenic River system.

After passing through another set of incised canyons, the Virgin moves on to Nevada and the town of Mesquite, which is situated on Flat Top Mesa. Another set of tributaries, located in the Tule Desert, are found here, including Beaver Dam and Sand Hollow Washes, as well as drainages in the Virgin and Mormon Mountains. The river then swings through the Virgin Valley, past Halfway Wash and the Overton State Wildlife Management Area,[2] and eventually enters the Lake Mead National Recreation Area from the north, where (depending upon the lake's level) it flows for some two miles before entering Lake Mead itself.

A River of Opportunity

Over the course of its 200-mile journey, the Virgin River supports a series of abundant, yet fragile, ecosystems. As will be detailed below, an astounding variety of rare wildlife species depend on the Virgin's largely unchecked flows for survival. Additionally, the viability of a myriad of other resources, ranging from recreational opportunities to riparian areas, are also directly linked to the health of the river.

However, the Virgin's future as provider for these values is tenuous. Opportunities and strategies available for the protection of waterways and their related resources, already

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[2] The Virgin River runs through the relatively undeveloped portion of Overton's land, as most of the area is served by the Muddy River. The Virgin side has remained undeveloped primarily because of the ephemeral quality of the river. Perhaps as a result, this side of Overton still contains some good riparian resources, although tamarisk invasion is becoming problematic. Interview with Butch Padilla, Overton State Wildlife Management Area, January 5, 1993.

successfully utilized on dozens of waterways throughout the country, have so far gone entirely unused on the Virgin. Much of the institutional failure to capitalize on these opportunities can be attributed to a combination of local water development traditions--which place little priority on the river's non-human demands--and the pressures emanating from federal, state, and local decisionmakers who work to ensure that these traditions will continue to determine management practices in the Virgin River basin.

Statutory approaches that could relax development pressures on the Virgin have yet to be implemented. Wild and Scenic River designation for the Virgin and many of its tributaries, for example, has suffered from by agency foot-dragging. As a result, waterways possessing world-class biological, historical, or scenic values remain threatened by the impacts of urban growth and the traditions of consumption-based management. The failure of the federal government to make designation of these waterways a priority for Virgin River management leaves it, along with Beaver Dam Wash, North Creek, the Santa Clara River, the Virgin North Fork, Ash Creek, and dozens of other critical waterways open to debilitating development projects.

Opportunities to protect specific river resources have also been wasted. Two native fish species--the woundfin minnow and the Virgin River chub--have been driven nearly to extinction after years of suffering the impacts of dambuilding and the consequent changes to natural stream environments. Both the woundfin and the chub are listed as "endangered" by the U.S. Fish and Wildlife Service. A third species, the Virgin River spinedace, is currently being considered for addition to the endangered species list.

Despite the dire condition of native fish habitat and populations in the Virgin River basin, laws requiring the timely listing of endangered species, the protection and expansion of their populations, and the designation of protected "critical habitat," have been violated. Interagency cooperative efforts to protect sensitive native species have also accomplished little, despite the fact that the sources of the species' decline--water development and the consequent impacts on the river--are well-known.

Administrative approaches have for the most part also remained untested. Several Areas of Critical Environmental Concern (ACEC) have been slated for designation in the Virgin basin. Delays in the final adoption of Resource Management Plans, though, have blocked

implementation of the protective management prescriptions assigned to these areas. And, even if ACEC designation should be completed at some point, these administrative classifications are relatively ineffective when compared to potential protections offered by statutory law.

Finally, the federal government's willingness to exercise its powers to protect instream resources has been inconsistent, and at times practically non-existent. Critical habitat for endangered native fish, for example, remains undesignated. The federal government also refused to request extensions on the deadline for filing reserved rights claims in wilderness areas, even though the status of reserved rights in wilderness areas is far from certain. After years of neglect, federal agencies--particularly the Bureau of Land Management and the National Park Service--are finally beginning to claim the water necessary to support the resources they are charged to protect. The process will take many years, however, due to the complexity of the water rights system; the time wasted in refusing to apply for rights in a timely manner further increases the risks already faced by the Virgin.

While the history of active attempts to protect the river has not been a proud one, there remains hope that an emerging recognition of the value of the Virgin and its resources will yield increased participation in ensuring its future. Plans to protect the Virgin River and its resources, if they are to be successful, must be made and implemented immediately. The Southern Utah Wilderness Alliance has determined that numerous sites in the Virgin River basin require special protective management regimes encompassing a combination of statutory and administrative approaches; such a program would necessarily require the involvement of all levels of government, from local councils to the federal agencies. SUWA's recommendations for river eligible for wild and scenic status, and for areas deserving ACEC designation, are outlined in Figures 30 and 31, and throughout the remainder of this report. Map 1 shows some of these areas also. Finally, SUWA recommends that all historical, current, and potential suitable habitat for native fish be designated "critical habitat" under the Endangered Species Act.

Virgin River Geology

As is the case with its geography, the Virgin River basin's geology is characterized by transitions. Though generally arid now, the region owes its unique makeup to a series of seas that rolled into the basin and later disappeared, either by receding or evaporating. These several

marine deposition events, which began in the Paleozoic era and continued through the Mesozoic, left behind an unusually complicated geological structure.[3]

Transgression events--the flooding of seas across landforms and the resultant deposit of sediments on that land--occurred at least twice during the Paleozoic era. Both involved seas moving across the basin from west to east, and ultimately receding from east to west. These events left behind uneven sedimentation levels of mostly sandstone, which were made even more inconsistent by winds that whipped the sands around after successive shorelines dried.

A third transgression event, marked by the movement and eventual evaporation of a shallow sea, occurred during the Kaibab period, and left heavy concentrations of gypsum behind. Rather than an even layering of deposits, this event resulted in the formation of a number of ponds, lagoons, small bays and other impoundments--which, in turn, localized deposits of the limestone, gypsum, and dolomite that precipitated out of the water.[4] The eventual disappearance of the Kaibab sea was followed by a long, dry period of terrestrial sedimentation, erosion, geologic uplift, and canyon incision.

The seas returned to the basin in the mid- to late Jurassic period of the Mesozoic era. Although the basin's climate at this time was generally semiarid, the middle Jurassic is characterized by a shallow sea that reached from Canada to approximately Mount Carmel Junction in Utah. Ephemeral streams formed in the later Jurassic deposited the sandy shales of the Moenkopi formation; the Jurassic also saw the formation of the Navajo sandstone layer and many of the most scenic formations in Zion National Park. This sea rolled out near the beginning of the Triassic period, which in turn ushered in yet another terrestrial period of erosion. The subsequent Chinle period brought a freshwater sea that deposited some ten feet of mud and other sediments in the basin. This sea then receded gradually, depositing the Kaiparowits formation.

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[3] Cook, E.F. Geologic Atlas of Utah, Washington County. Utah Geologic and Mineral Survey: Salt Lake City (1960) [at 9]. In fact, every activity period of the Paleozoic and Mesozoic is represented in the basin's sedimentary sequence--a sequence that left behind a sedimentation record some 19,000 feet thick in places.

[4] Cook, at 93.

The Cenozoic era, characterized by igneous activity and rapid erosion, followed; its legacy is the volcanic material found throughout the basin, particularly near Pine Valley Mountain. More important, however, is the overall legacy of the basin's geologic formation. The repeated pattern of seas flowing in and out of the basin produced a landscape of gypsum, sandstone, and other highly erodible soils. The effects, both on water quality and on the region's suitability for dambuilding, would become apparent as water planners looked to exploit the Virgin for human uses.

A Basin of Transitions

Southwest Utah--more specifically, the sixty-mile span of Washington County, Utah--forms the center of a large region of striking transition between the Grand Staircase and Basin/Range geologic provinces.[5] The former contains landmarks such as Zion National Park's Kolob Terrace region, and is marked by relatively flat plateau lands interrupted by erosional forms incised by the Virgin River. The Basin/Range region, which lies to the west of the Grand Staircase, is on the other hand characterized by generally dry, heavily folded and faulted landscapes.[6]

In addition to this east/west transition, the county straddles a significant north-to-south transition. This is especially evident in the noticeable drop in elevation realized when moving southwest through the Virgin River basin. Washington County, then, essentially lies atop the crossroads of two pairs of intersecting landscapes.[7]

The diversity of the Virgin River landscape in turn blesses the region with an unusually diverse biological community. As it flows from Zion to Lake Mead, the river literally descends

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[5] Stokes, William Lee. Geology of Utah. Utah Museum of Natural History: Salt Lake City (1986) [at 239].

[6] Cook, at 9.

[7] Dalley, Gardiner F., and Douglas A. McFadden. The Archeology of the Red Cliffs Site. Department of the Interior, Bureau of Land Management, Utah State Office: Salt Lake City (1985). Volume 17 in Cultural Resource Series [at 18, citing Meyer, Susan E. Annotated Checklist of the Vascular Plants of Washington County, Utah (Master's thesis). University of Nevada: Las Vegas (1976)].

a staircase of landscape and climate types, beginning with the relatively cool, subalpine ranges of the Colorado Plateau, moving through the arid Mohave region, and finally halting at the edge of the Sonoran zone. Each "stair," of course, is home to a particular mix of adapted wildlife. The Virgin River corridor provides habitat for an untold variety of species, including many classified as endangered, threatened, candidate, or sensitive.

The transitional areas between these landscapes, known as "ecotones,"[8] are likewise unusually biologically diverse. Since ecotone regions--other examples of ecotones include coastal areas, forest/field edges, and forest/floor habitats[9]--are by definition shared by representatives from the species mix found in each of the two boundary areas, they contain characteristics unique to each. Ecotones serve as both barriers to and corridors between species groups, and overall provide habitat useful to some and entirely useless to others.[10]

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[8] The concept of "ecotones" predates even that of "ecosystem." The former was first applied in the late nineteenth century by F.E. Clements, who realized that "...the transition zones between plant communities had properties distinct from either of the adjacent communities." Hansen, Andrew J., and Francesco diCastri (eds.). Landscape Boundaries: Consequences for Biotic Diversity and Ecological Flows. Springer-Verlag: New York (1992). Volume 92 of Billings, W.D. et al., Ecological Studies [at v].

Biological literature from the first half of the twentieth century also stressed the unusual level of diversity in ecotone areas. Both Leopold, in Game Management (1933) and Beecher, in Nesting Birds and the Vegetative Substrate (1942) focus particularly on the special characteristics of these transition zones. Wiens, John A. "Ecological Flows Across Landscape Boundaries: A Conceptual Overview." In Hansen, Andrew J., and Francesco diCastri (eds.). Landscape Boundaries: Consequences for Biotic Diversity and Ecological Flows. Springer-Verlag: New York (1992). Volume 92 of Billings, W.D. et al., Ecological Studies [at 218].

[9] Hansen, Andrew J., Paul G. Risser, and Francesco diCastri. "Biodiversity and Ecological Flows Across Ecotones." In Hansen, Andrew J., and Francesco diCastri (eds.). Landscape Boundaries: Consequences for Biotic Diversity and Ecological Flows. Springer-Verlag: New York (1992). Volume 92 of Billings, W.D. et al., Ecological Studies [at 423].

[10] diCastri, Francesco, and Andrew J. Hansen. "The Environment and Development Crises as Determinants of Landscape Dynamics." In Hansen, Andrew J., and Francesco diCastri (eds.). Landscape Boundaries: Consequences for Biotic Diversity and Ecological Flows. Springer-Verlag: New York (1992). Volume 92 of Billings, W.D. et al., Ecological Studies [at 10].

Because they in many cases define the limits of the physical range of particular species, these transition zones are acutely affected by environmental impacts.[11] Ecotone-area impacts tend to be more pronounced, and tend to occur more quickly, than in surrounding landscape areas.[12] Overall, then, the Virgin River ecosystems are immensely fragile, in terms of both wildlife population viability and in quantity and quality of suitable habitat. The river is, in many cases, an integral component in each of those systems. It is becoming clearer that the health of the ecotone stairway depends directly upon the health of the free-flowing Virgin.

Surface Water Quantity and Quality

The Virgin River's flow is highly variable, running especially high in the spring months when winter snowpack is melting and often disappearing in places during the summer months, particularly when agricultural diversions are operating at their highest volumes. The average annual flow at the Virgin gaging station--upstream from most major diversions--is 130,610 acre-feet per year.[13]

In addition to water quantity, water quality is of particular concern to Virgin River managers. Unfortunately, the river is subject to water quality impacts from two general sources.

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[11] Delcourt, Paul A., and Hazel R. Delcourt. "Ecotone Dynamics in Space and Time." In Hansen, Andrew J., and Francesco diCastri (eds.). Landscape Boundaries: Consequences for Biotic Diversity and Ecological Flows. Springer-Verlag: New York (1992). Volume 92 of Billings, W.D. et al., Ecological Studies [at 19].

[12] Hansen, Risser, and diCastri, at 424. There is some disagreement regarding the pace of change in ecotones. Delcourt and Delcourt, for instance, have stated that "Population responses and subsequent adjustments of a given ecotone may occur immediately, or they may be significantly behind either biological or environmental changes," at 51.

[13] Utah Department of Natural Resources, Division of Water Resources. Utah State Water Plan: Kanab Creek/Virgin River Basin (Public Review Draft) [hereinafter Utah State Water Plan] (1992) [at 5-8]. An "acre-foot" is the amount of water needed to cover an acre of area to a depth of one foot--about 326,000 gallons.

See Figure 1, which illustrates the average inflows and outflows on the Utah portion of the Virgin River. Utah State Water Plan, at 5-5. Also, see Figures 2 and 3, which present gaging station data from Littlefield, AZ and Hurricane, UT. These figures were developed from data supplied by the United States Geological Survey.

On one hand, the Virgin is degraded through the usual, human-based pathways--heavy metals, many carcinogenic, from abandoned mines at Silver Reef and from industry, have leached into tributaries and the mainstem.[14] Levels of biological oxygen demand (BOD), due primarily to animal wastes entering the hydrologic system, have been a problem at a limited number of sites, including East Fork and LaVerkin Spring. High concentrations of fertilizers and pesticides have been detected in agricultural runoff and return flows.[15]

Characteristics inherent in the Virgin River basin also result in impaired water quality. The soils of the region, for example, are generally quite saline and erodible. When coupled with the unusually high evaporation rates found in irrigated agriculture,[16] Total Dissolved Solids (TDS) concentrations often exceed levels acceptable for domestic use, if not for agricultural use.[17] As mentioned above, high salinity inflows at LaVerkin Springs are a concern, as are saline inflows in the Fort Pearce drainage and several other spots.[18] Various heavy metals are

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[14] Webb, Loren. "Toxic Testing Conducted In Silver Reef." The Daily Spectrum (n/d).

[15] See Figures 4 and 5 for water quality data. Five County Association of Governments. Virgin River Basin Study: Water Quality (Appendix) [hereinafter FCAoG Study] (September 1989) [at 22 and at 17, respectively].

[16] Irrigated water is lost to evaporation at rates ranging from 50 to 70 percent, increasing salt concentrations by 200 to 300 percent. These salts, along with other contaminants, often enter the waterway in agricultural return flows. FCAoG Study, at 16.

[17] The Utah State Water Plan points specifically to TDS concerns, noting that "[t]he average TDS values on the Virgin River exceed the state standards at all [gaging] stations downstream from and including LaVerkin Springs." Utah State Water Plan, at 12-6.

On the other hand, the Virgin's high salinity does tend to favor some wildlife, including the endangered woundfin minnow, over the non-native fishes that cannot survive conditions in much of the river. Memo from Regional Director, Region 6 U.S. Fish and Wildlife Service, to Lower Colorado Region Director, Bureau of Reclamation (n/d).

[18] Note that suspended solids and sediment may at times benefit cropland by providing higher organic silts, but can also damage cropland by forming impervious soil layers. Utah Department of Natural Resources, Division of Water Resources. Hydrologic Inventory of the Virgin and Kanab Study Units [hereinafter Hydrologic Inventory] (1983) [at 71].

released in small quantities as geologic structures weather.[19] Particular problem areas include the East Fork (maximum TDS exceeds standard by about 65%), the North Fork (where iron deposits are twice the standard), North Creek (high cadmium and mercury levels), LaVerkin Creek (cadmium, mercury, and lead are above standard), Ash Creek (600% over standard for iron, 700% over for phosphorous), the Santa Clara River (chromium, lead, mercury, and cadmium all above standard), and the Virgin mainstem (mercury, cadmium, lead, and silver levels exceed standards). Measurements taken at the Bloomington gage--the water quality station furthest downstream in Utah--show iron 350% over standard, and TDS too high by more than 300%.[20] Overall, almost ninety percent of Utah's segment of the Virgin River fails water quality standards, because of excesses in TDS, temperature, and metals content, to fully support the human uses designated for it by USGS.[21]

Water quality problems are not limited to Utah's run of the river. In Nevada, for example, the Bureau of Land Management notes that the Virgin consistently exceeds federal drinking water standards, as well as state standards for TDS and fecal coliforms.[22]

Groundwater Quantity and Quality

The hydrological system of the Virgin River basin is, of course, not limited to surface water. Groundwater, in varying quantity and quality, is present throughout the region in the form of springs and underground aquifers. These underground resources are applied to public and domestic water uses, agricultural irrigation, and some stock watering.

Underground water is linked hydrologically to surface supplies. In many cases, groundwater springs and seeps enhance surface flows while, in other instances, surface flows

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[19] FCAoG Study, at 9.

[20] FCAoG Study, at 10.

[21] Utah Department of Environmental Quality, Division of Water Quality. Water Quality Assessment for 1992 [Section 305(b) Report] (August 1992) [at 14-15].

[22] United States Department of the Interior, Bureau of Land Management, Stateline Resource Area. Draft Stateline Resource Management Plan and Environmental Impact Statement [hereinafter Stateline RMP] (1992) [at 3-17].

find their way into aquifers or other groundwater storage units. In either case, the depletion of groundwater supplies, the contamination of groundwater quality, and/or the disruption of groundwater movement patterns can in turn adversely affect the quantity and quality of surface supplies.

The preeminent groundwater resource in the basin is the Navajo Sandstone Aquifer unit.[23] This sandstone formation--visible in the majestic views of Zion National Park--is 2200 feet thick in places, and rests beneath about three-quarters of the basin. These unconsolidated rock aquifers account for 80% of the well water used in the basin.[24]

The region's groundwater quality is uneven at best, and often falls short of standards for various salts and other dissolved solids, heavy metals, and organic compounds, as well as for temperature, taste, odor, acidity, and hardness. Clyde, in his review of Utah's groundwater supplies, determined that since "water quality in the Virgin Basin varies from excellent to unusable for drinking or irrigation, it is clear that water quality will be a major constraint on the future development of groundwater."[25] Further, the need for limits on future groundwater development--not to mention on those lands overlying aquifer recharge areas--is an equally critical concern:

> The Navajo sandstone aquifer and its priceless supply of high quality water in the Central Virgin River Basin are especially vulnerable to pollution by the activities of people...In this uncovered, potential recharge area the aquifer is exposed to whatever contaminants are in the precipitation and the streamflow or to whatever

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[23] Other major aquifers in the area include the Claron, the Straight Cliffs sandstone, the Wahweap sandstone, the Carmel, Kayenta, Moenave, Chinle, and Moenkopi formations, and the Kaibab limestone. Clyde, Calvin G. Groundwater Resources of the Virgin River Basin. Utah Water Research Laboratory: Logan, UT (1987) [at 11].

[24] Hydrologic Inventory, at 61.

See Figure 6 for groundwater storage volumes. Clyde, at 22.

[25] Clyde, at 33. See Figure 7, which shows TDS ranging from 110 mg/l to 9400 mg/l. Clyde, at 34.

is left in or on the land by people. Use of the outcrop areas must be controlled if the good quality of the Navajo aquifer water is to be preserved.[26]

As many as 800 springs are believed active in the region. Major springs supplanting the Virgin River include Toquerville Spring, a relatively high flow (30 cfs) source of excellent quality (460 mg/l TDS), and LaVerkin Hot Springs, which provides only minimal flows (11 cfs) and contributes a huge TDS load to the river (over 9000 mg/l).[27] The flow at LaVerkin Spring is so saline that it is unfit for practically any use, and in fact severely impacts the overall water quality of the Virgin itself--at least as regards human uses. Although plans to desalinize LaVerkin Spring by either mechanical or evaporation processes have been proposed, all have so far been rejected due to the prospect of poor economic returns.

The Virgin's more fortuitous characteristics, including its route through several distinct lifezones and its active groundwater mechanisms, often are countered by inherent shortcomings, such as geologic-based impediments to water quality. Such are the limitations and opportunities offered by the river. While the river is inherently able to provide for a rare and unique array of indigenous wildlife, its ability to do so is threatened by the demands made upon it by consumptive human uses. This conflict is nothing new however, as even the earliest inhabitants of the Virgin River basin faced a water resource that could at once serve and destroy the livelihood of its dependents.

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[26] Clyde, at 36.

The urbanization of the Virgin basin presents particular problems with protecting groundwater quality. In February 1993, for instance, two St. George businesses were fined by Utah's Department of Environmental Quality after they failed to mitigate leaking underground storage tanks. According to one newspaper account, a state health district engineer noted that "as much as three feet of [gasoline] was floating on the ground water when the tanks were pulled, but we don't know what the extent of the contamination is now, because no assessment has been done." Lindquist-Applegate, Julie. "First Fines Issued for Leaky Gas Tanks." The Daily Spectrum (February 13, 1993).

[27] Clyde, at 16.

Basin Prehistory

Human attempts to create a permanent settlement in the Virgin River basin began some 8000 to 9000 years ago in the Paleoindian era. Most of the archeological record of that time has been lost to erosion and other natural processes, however, so little of that particular civilization is fully understood. Equally unknown are the so-called Archaic peoples, a group of nomadic basketmakers that remained in what is now the American Southwest for approximately 6000 years.

Knowledge of prehistoric cultures in the region, then, begins generally with groups known collectively as the Anasazi, or "Ancient Ones." The Anasazi are recognized by most for the pueblos and kivas that still dot the cliffs and countryside of the southwest. Despite the rich archeological record originally left behind, rampant site vandalism, natural weathering, and other factors have made it difficult for researchers to establish a chronology for the Anasazi.

A recent Bureau of Land Management study at the Red Cliffs site (near the present-day Red Cliffs Recreational Area), however, posits that the culture originated in the Basketmaker III era, somewhere between A.D. 500 to 700.[28] The Basketmaker III group populated the Little Creek Mountain Area, although evidence of its location on the Virgin River itself is sparse. Basketmaker III gave way to Pueblo I, which centered alongside the Virgin, particularly in the East Fork area, from about A.D. 700 to 800. Pueblo II followed with an equally wide distribution of population, and occupied the same general region until as late as A.D. 1050. Overall, the Red Cliffs region shows a fairly consistent Anasazi presence from about A.D. 470 to A.D. 1140. As is often the case, there is no evidence regarding why the site was abandoned at that time.

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[28] Dalley and McFadden, at 42.

Other study sites in the Virgin River basin include Little Creek Mountain, Quail Creek, and Green Spring. See Walling, B.A. et al. Excavations at Quail Creek. Department of the Interior, Bureau of Land Management Utah State Office: Salt Lake City (1986). Volume 20 in Cultural Resource Series. Also see Walling, B.A. et al. Green Spring. Department of the Interior, Bureau of Land Management Utah State Office: Salt Lake City (1987). Volume 21 in Cultural Resource Series.

Another group of researchers studying the Little Man site suggested a somewhat similar chronology, beginning with the Archaic at about A.D.1 and continuing through Basketmaker II.[29] The Little Man site, however, provided evidence of Basketmaker III occupation as early as A.D. 300. Its findings regarding Pueblo I and II, though, are substantially the same at the Red Cliff site. As was the case with Red Cliffs, the Little Man settlement was essentially isolated, and showed no evidence of imported tools or other technologies.

Overall, Virgin Branch Anasazi sites were located throughout the Virgin system, beginning near the head of the East Fork to as far south as Overton, Nevada, near the present-day mouth of the river.[30] While these settlements' proximity to the Virgin River would indicate a river-dependent culture, there is no evidence that the Anasazi utilized riverine resources like streamside plants, fish, and waterfowl.[31] Rather, the site choice appears to be agriculture-related. Even this is not certain, given the lack of evidence regarding Anasazi agricultural practices:

> It has been indicated that there is no possible way to practice agriculture in the [basin] area without ready access to live water. For the prehistoric populations, this is confirmed by the placement of Anasazi habitation sites [alongside the Virgin River]... Exactly how the water was utilized, however, has not been addressed due to lack of direct evidence. In all probability, any vestiges of water control arrangements, if such were used, have been lost to floods or historic activities.[32]

Unfortunately, the minimal record still remaining after years of degradation is becoming only more unreadable. The Little Man researchers noted that "...we are outright losing the river-associated Anasazi resource located on private lands, as well as taking pressure and abuse on

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[29] Dalley, Gardiner F. et al. The Little Man Archeological Sites: Excavations on the Virgin River Near Hurricane, UT. Department of the Interior, Bureau of Land Management Utah State Office: Salt Lake City (1988). Volume 23 in Cultural Resource Series [at 150].

[30] Dalley et al., at 14.

[31] Dalley et al., at 289.

[32] Dalley and McFadden, at 158.

the federal sites; the latter factors involve development demands and increased population as well as concomitant exposure risks."[33] As shall be clear within, this is only one of the Virgin's many resources that is rapidly disappearing under the strain of growth and development.

Colonial History

Following the demise of the Anasazi, groups of Uto-Aztecan hunter/gatherers--the Paiute--flourished. Paiute settlements alongside Ash Creek (near what is now Toquerville, Utah) were, like those of their predecessors, based on irrigated agriculture. Increasing European influence also became evident during this era. The Spanish, who entered the Colorado River region in the 1550s, were the first explorers in the basin. They were followed by the Escalante[34] expeditions during the first years of American independence, and by Fremont[35] in the early 1800s. As more of the Southwest was brought under European control, the Paiute were forced off their ancestral lands and onto reservations.

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[33] Dalley et al., at 4.

[34] Escalante first entered the Virgin River valley in 1776. He referred to the Virgin as the *Rio Sulfero*--the Sulfur River. Upon reaching the confluence of the LaVerkin and Virgin, he wrote in his October 15 journal entry "Here there is a beautiful grove of black poplars, some willow trees, and rambling vines of wild grape...there are ash-strewn areas, veins and other mineral indicators, and many rocks smeared with mica." Warner, Ted J. (ed.). The Dominguez-Escalante Journal. Brigham Young University Press: Provo, UT (1977) [at 80].

[35] Fremont's explorations brought his party to the Virgin River near present-day Riverside, Nevada. They also passed through Littlefield, Arizona, as well as the Beaver Dam Mountains and the Santa Clara region.

His journal entry of May 5, 1844 speaks of a stream "...running towards the southwest, and [appearing] to come from a snowy mountain in the north. It proved to be the Rio Virgen, a tributary to the Colorado...On the evening of the 8th, having travelled 28 miles up the river from our first encampment on it, we encamped at a little grass plat, where a spring of cool water issued from the bluff. On the opposite side was a grove of cottonwoods at the mouth of a fork, which here enters the river. On either side the valley is bounded by ranges of mountains, everywhere high, rocky, and broken." Bigelow, John. Memoir of the Life and Public Services of John Charles Fremont. Derby and Jackson: New York (1856) [at 113].

White settlement of the area began around 1852 and, by 1860, at least eight small Mormon townships were established in what is now Washington County: Harmony, Santa Clara, Gunlock, Washington, Heberville, Pine Valley, Toquerville, and Pocketville. The city of St. George, now the largest in southwest Utah, was settled by 300 families in 1861.[36]

Not surprisingly, one of the most difficult tasks for the original settlers was procuring water for domestic uses. Ditches for culinary water often ran directly through livestock corrals in the earliest days of St. George, leading to extremely poor water quality and a "sorrowful" mortality rate among the town's children.[37] Not until 1937, when a pipeline from the Cottonwood stream near Pine Valley Mountain was completed, did the town have an enclosed culinary water system. In addition to alleviating health risks, the pipeline improved water supply by minimizing evaporation and other conveyance losses.

Though the first days of St. George saw some mining activity--mostly gold, silver, copper, coal and gypsum--as well as some minimal oil exploration, the primary industry was agriculture. As a result, a complex and extensive network of canals, diversions, and small dams was built; many can still be found throughout the basin, particularly in the St. George/Washington Fields region. In fact, the majority of the Virgin's flow still serves the agricultural sector--much of it still utilizing the same technology of open ditches and crude canals that irrigated the fields of St. George's first settlers.

Ironically, much of what limited the sector in the mid-1800s continues to limit it today. St. George, as an outpost of sorts, was geographically distant from the major markets for its products. Further, its poor soils, as well as inconsistent prices for agricultural products during that period, often combined to make agriculture in Washington County little more than a subsistence industry.[38]

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[36] Histories of Mormon settlement in the Basin include Arthur Hafen's Dixie Folklore and Pioneer Memoirs, Andrew Larson's I Was Called to Dixie, and Charles Peterson's Life in a Village Society.

[37] St. George, City of. Making the Desert Bloom. Publishers Place, Inc.: St. George (1991) [at 11].

[38] Hydrologic Inventory, at 20 [citing Utah Historical Society. Utah's Dixie: The Cotton Mission. Salt Lake City, Utah (1961)].

Early Water Development: The Dixie Project

The first major water development project in southwest Utah was the construction of Kolob Reservoir in the early 1950s. Originally envisioned as part of the multi-reservoir Dixie Project, Kolob was built to serve primarily the needs of Cedar City and, to a lesser extent, those of several downstream agricultural users. Kolob Reservoir continues to provide water for Cedar City today; however, the city is considering alternatives for future water supply.

A number of other water storage proposals were advanced for the Washington County area beginning in the 1960s. To meet planning needs, Washington County voters approved formation of the Washington County Water Conservancy District (WCWCD) in 1962 to act as local sponsor for federal Bureau of Reclamation (BuRec) projects.[39] The first plan to emerge from this arrangement was the Dixie Project, which eventually included recommendations for development on lands southeast of St. George and along the Santa Clara River. By 1976, however, proponents abandoned the Dixie Project due to its high costs (estimates ran as high as $60 million), the lack of secure, non-leaking reservoir sites, and the inability to attach a hydropower generating (and revenue-enhancing) component to the plan.[40]

The Gunlock Reservoir, which lies northwest of St. George on the Santa Clara River, was also envisioned as part of the larger Dixie Project.[41] However, when the federal government elected to drop its original plan to construct Gunlock, St. George adopted the site. With a $300,000 grant from BuRec, the city undertook construction in 1970, completing the dam and reservoir less than a year later. However, additional funds for a water treatment plant were never appropriated, so Gunlock produces no culinary water; instead, its waters are used for irrigation and recreation purposes.

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[39] Special district statutes, as they apply to water conservancy districts, are found at U.C.A. §17A-2-1401 et seq.

[40] Hydrologic Inventory, at 116.

[41] Making the Desert Bloom, at 41.

Warner Valley

Around the time of the collapse of the Dixie Project, the WCWCD proposed a combination energy and water development for the Warner Valley area of the basin. The Warner Valley plan, part of the even more ambitious Allen-Warner Valley Energy Project, included a coal-fired generating plant near St. George, as well as a second generator located near Las Vegas. A diversion at Timpoweap Canyon and an offstream reservoir system were to be placed in Warner Valley to store 55,000 acre-feet of water that would serve both the generating stations and the local population. Thirty thousand acre-feet were to be set aside for M&I use, and another 6500 acre-feet exported to Cedar City.[42] After exhaustive economic and environmental review, including the preparation of an environmental impact statement (EIS), BLM decided that several factors, primarily less-than-anticipated electricity demand but also including concerns about the generating plants' impacts on air quality in the national parks and the requirement to protect the endangered woundfin minnow, made the proposal infeasible.[43]

Watershed: The Quail Creek Reservoir

By the early 1980s, prospects for large-scale water development on the Virgin River appeared bleak: two major proposals had been rejected and, further, the federal government was holding to its promise to withdraw from project financing. At the same time, there remained a perception, at least among many water planners, that a system of reservoirs was needed to prevent the Virgin River from escaping downstream.

With that in mind, WCWCD suggested in November 1982 a "Master Plan" which included a list of nine project proposals. Sites for potential dam and/or reservoir construction

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[42] Owen, Allon Calvin. Impact of the Warner Valley Reservoir on the Hydrology of the Virgin River (Master's thesis). University of Utah: Salt Lake City (1979) [at 53]. Between exports, reservoir evaporation, and consumptive uses, Warner would have depleted about 24,000 acre-feet of Virgin River water per year.

[43] An October 15, 1980 memo from the United States Fish and Wildlife Service (FWS), Salt Lake City, to BLM's Utah State Director notes that "It is our opinion that the Warner Valley Water Project would affect the woundfin [minnow] in much the same way as the drought in 1977, with its serious localized impacts on the fish. However, the Warner Valley Project impacts would occur yearly rather than once in 30 years."

included Warner Valley, Shoal Creek, Moody Wash, Ash Creek, and Fort Pearce Wash. Construction on the North Fork and East Fork of the Virgin--both in proximity to Zion National Park--was also considered. Another site mentioned was the Quail Creek region, on a small waterway near the town of Harrisburg.

WCWCD finally decided on the Quail Creek site. Initial cost projections for the project were in the $12-$14 million range, though the State of Utah's Board of Water Resources later pushed that projection to $19 million. At any rate, Washington County taxpayers overwhelmingly passed a $20 million bond referendum, backed by a low-interest loan from the state, to pay for a diversion dam on the Virgin, an underground pipeline to run water from the diversion to the reservoir, and a 40,000 acre-foot reservoir.[44] The entire project was designed, engineered, and built under the direction of WCWCD.

Quail Creek was plagued by a variety of problems, ranging from economics to engineering to public relations, during the course of the planning and construction phases. Of particular concern was the environmental analysis process, as the proposal was evaluated only in a cursory environmental assessment (EA), rather than a more detailed EIS, thus limiting

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[44] The financing scheme engineered to pay for Quail Creek has been tinged by hints of financial scandal. According to one observer, "The Washington County Water Conservancy District got a sweet deal from the state in financing its Quail Creek Reservoir--it ended up repaying only about 40 percent of a bond it had originally sold the state for $18 million." Bauman, Joseph. "Quail Creek Reservoir Was a Real Bargain for County." Deseret News (January 11, 1989).

As evidence for his assertion, Bauman outlines the following chronology: (1) In 1983, the Utah State Legislature approved a $50 million bond issue, with $20 million of that going to State Board of Water Resources for water development; (2) In September 1983, the Board of Water Resources purchased an $18 million bond from WCWCD as the main financing tool for the $21 million Quail Creek project; (3) by 1985, dam leakage was noticed and another $1.5 million for grouting and other procedures to stop the leakage was made available, bringing the total cost of the dam to about $22.3 million. Utah found itself contributing $19.05 million, which WCWCD was to repay at 2.6% interest over 50 years; (4) WCWCD's first payment was due in 1987. However, the Utah Legislature in 1986 passed a bill that allowed the Water Resources Board to remarket the bond it originally purchased from WCWCD; (5) WCWCD then "repurchased" the original bond for $7.45 million--about 40% of the original $18 million first issued by WCWCD.

opportunities for agency review and public participation in the decisionmaking process. Perhaps more importantly, potential environmental impacts received only minimal study, due mostly to the decision to restrict the analysis to a 30-page EA. Concerns expressed by the Utah Geological and Mineral Survey regarding the site's geology and the lack of adequate study about the site, for example, were effectively ignored by other state officials.[45] Some 70 culturally significant sites, including nine petroglyphs, were found during an inventory of the site. Though these sites were determined to be scientifically critical, the EA supported a decision to proceed with the project and accept impacts to the sites.[46] Finally, rumors that WCWCD cut corners during construction abounded, as did concerns about the project's ultimate economic viability.

Another weakness in the environmental review process became evident after WCWCD made significant changes in project plans after the EA had been completed.[47] These changes,

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[45] Bauman, Joseph. "As Flood Cleanup Progresses, Dike Probes Begin." Deseret News (January 14, 1989).

The Utah Geological and Mineral Survey repeatedly attempted to meet with state officials in order to discuss its concerns about the site's geological characteristics. However, continued requests from UGMS field surveyors Don Mabey and Bruce Kaliser to further consult with the Utah Division of Water Resources eventually went unanswered. Kaliser, in a 1982 memo to the then-Director of Water Resources Daniel Lawrence, also noted that critical geological information from the Bureau of Reclamation was missing from reports supplied by the Division.

[46] United States Department of the Interior, Bureau of Land Management, Cedar City District. Final Environmental Assessment: Quail Creek Reservoir Project (August 15, 1983) [at 27]. The cultural resource review attached to the EA noted that the Quail Creek sites promised to yield data "that [would] bear directly on source of the major issues involved in the study of the prehistoric people of the Intermountain region. Few such opportunities remain in the St. George basin." Thompson, Richard A. A Cultural Resource Inventory of the Quail Creek Reservoir and Pipeline Project Area. International Learning and Research, Inc.: Cedar City (1983) [at 7].

[47] The original plan was to run a pipeline from the Quail Creek diversion dam to LaVerkin Canal, through the town of LaVerkin, and down to the reservoir. However, the plan later was changed to move the pipeline downstream to just below Pah Tempe Springs. This change required burying the pipeline, which in turn led to cutting into the spring's hot water veins. Only later did engineers realize that the spring's heavily saline water would corrode the pipelines. WCWCD attempted to exercise eminent domain to take

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however, were generally not exposed to any additional assessment, an apparent violation of the National Environmental Policy Act (NEPA).[48] For example, amended plans that included a hydropower component were implemented without being subjected to any substantive environmental analysis, despite a statement in the EA that the addition of hydropower at some future date would result in different environmental impacts emanating from the site, due mostly to changes in the river's flow regime.[49]

The United States Fish and Wildlife Service (FWS) also indicated in its comments on the EA that hydropower would have major impacts on the endangered woundfin minnow.[50] Finally, the decision to add hydropower capabilities to the project required that the diversion system operate at all times, rather than only at times of high runoff, which had been the intent when the EA and the Biological Opinion were prepared.[51] The original plan was designed to ensure habitat mitigation and minimum streamflows for river resources. The decision to divert water even in period of lower flows also was not reviewed in any substantive manner.

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[47](...continued)
over the entire spring area, a move which eventually led to litigation and WCWCD's defeat.

[48] National Environmental Policy Act, 43 U.S.C. §4321. NEPA regulations require that a supplement to the existing environmental analysis be completed if there are "substantial changes in the proposed action that are relevant to environmental concerns" [40 C.F.R. §1502.9(c)(1)(i)].

[49] Allred, Marc. Analysis of Environmental Assessment of Quail Creek (Monograph). Salt Lake City, Utah (n/d).

[50] Memorandum from Field Supervisor, Ecological Services, U.S. Fish and Wildlife Service, to Bureau of Land Management, Cedar City District Manager, February 23, 1983 [at 5].

[51] United States Department of the Interior, Fish and Wildlife Service. Quail Creek Reservoir Project Biological Opinion (December 7, 1982) [at 3].

Despite these initial problems, the project moved ahead quickly and was completed in 1985.[52] By 1987, the entire storage capacity of the reservoir was utilized.

Soon after the reservoir began filling, however, inspectors noticed that the dike was leaking; beginning in 1987, hundreds of grout holes were drilled and filled in the dike, and a cutoff trench was installed to block water flow.[53] These proved to be temporary fixes, however, when on December 31, 1988, observers noticed a flow of colored water emanating from the dike--indicating that the soils beneath the structure were washing away. By midnight, as local citizens were welcoming in the New Year, a 200-foot section of the dike collapsed, sending a wall of water--flows as high as 60,000 cfs[54]--rushing toward St. George. The initial rush of water took with it several bridges and an undetermined number of farm animals, and eventually forced the closure of Interstate 15 in the Virgin River Gorge. By 2:00 a.m., local radio station signals disappeared. The Emergency Broadcasting System was activated, and relayed its warning message through the dark night to those living downstream from Quail Creek: "*Dam Failure, Dam Failure, Dam Failure...Life threatening conditions now exist from immediately below the Quail Creek Dam along the Virgin River all the way to the Utah-Arizona border. All evacuations of affected persons should be completed or be rushed to completion.*

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[52] Also during 1985, the flow of the Virgin River began to disappear into a sinkhole that developed in the riverbed below the Quail Creek diversion. At that same time, flows from Pah Tempe Springs increased dramatically, elevating conductivity and affecting the stream's temperature and turbidity. During 1985, therefore, "water quality characteristics over more than 50% of the best woundfin habitat in [the] Virgin River...did not meet conditions described in the Environmental Assessment [citation omitted]." Deacon, James E. "The Endangered Woundfin and Water Management in the Virgin River, Utah, Arizona, Nevada." 13 Fisheries 18 (January 1988) [at 3].

[53] Bauman, Joseph. "Crews Battled to Repair Leaks in Dike Since '87." Deseret News (January 29, 1989).

[54] Given that one gallon per minute of flow equals about .002228 cfs, flows following the Quail Creek breach ran as high as 27 million gallons a minute.

This is a very dangerous situation. The Quail Creek reservoir is a large reservoir...and a huge volume of water is now racing down the stream along the Virgin River...."[55]

A total of some 30,000 acre-feet passed through St. George and eventually into the Virgin River Gorge over the next few hours, causing some $12 million in damage to houses, apartment buildings, businesses, and farmland.[56] Costs for reconstructing what came to be known as the South Dam were $12 million.[57]

The extent of the dam break's impacts on wildlife population and habitat will never be known. During a three-day survey by the U.S. Fish and Wildlife Service, the Utah Division of Wildlife Resources, the Arizona Department of Game and Fish, and a WCWCD-hired consulting biologist, researchers sampled the Virgin as far downstream as Riverside, Nevada; Don Archer of FWS noted that "[i]t was pretty evident that all [fish] species were significantly impacted by the flood event down there--even devastated. We saw very few fish from the Quail Creek breach to Riverside." Overall, the survey team found that four and one-half miles of native fish habitat--the region between the reservoir and the diversion dam that was once the best

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[55] Bybee, Darrell, and Loren Webb. "Dreams and Dollars Go Down the River." The Daily Spectrum (n/d).

[56] Failure of the site was eventually attributed to the dissolution of gypsum in the soil at the base of the dam, which led to the dam being undermined, and in turn forced its collapse. Bauman, Joseph. "Unsealed Foundation Blamed." The Deseret News (March 8, 1989).

WCWCD had only $1 million in liability insurance at the time of the disaster. Webb, Loren. "Price Tag On New Dam Might Hit 9 Million." The Daily Spectrum (n/d). Another $3 million was made available to the District for liability purposes via a twelve-year, no-interest loan from the State.

[57] Utah Department of Natural Resources, Division of Water Resources. Feasibility Report & Committal of Funds: Conservation and Development Fund (October 27, 1989). The $12 million State-sponsored loan was made at no interest, with a payback period of twenty years.

woundfin habitat in the Virgin basin--was destroyed.[58] In a separate study, FWS observed that "woundfin numbers were probably reduced" when the dike collapsed.[59]

At one time, much of the citizenry of Washington County viewed the dam as a huge step forward in the growth of southwest Utah. Then-Governor Scott Matheson spoke for many when he noted at the dam's groundbreaking ceremony in November 1983 that

> The Quail Creek Project, which we begin today, typifies the kind of project which I always envisioned our revolving fund could help: It has strong local support...It has a strong local sponsor...It provides multiple benefits...and finally, it was carefully planned.[60]

By the time the wall of water had raged through St. George, however, many were reacting quite differently. A headline in St. George's local paper, The Daily Spectrum, asked rhetorically "Who will pay for millions in losses?"[61] A letter to the editor in the January 11, 1989 issue of the same paper stated "I believe it is time to start putting the best interests of the citizens of St. George ahead of a few special interest groups. There are clearly a number of questions which demand answers, one of which is how the city of St. George can refuse to accept any responsibility for this disaster." Another letter put it even more bluntly: "Let's put the blame [for Quail Creek] where it belongs, and I believe it belongs with the Washington County and Southern Utah Water Conservancy [*sic*] management."[62]

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[58] Webb, Loren. "Fish Population Impacted By Flood." The Daily Spectrum (January 23, 1989).

[59] Memorandum from Assistant Field Supervisor, FWS Fish Enhancement Division, Salt Lake City, to Bureau of Land Management, Cedar City District, April 23, 1992, at 2. The memo also notes that, in the course of WCWCD's repair work, "[t]here was no attempt to offset losses of habitat and numbers of woundfin."

[60] Sorenson, Alleen. "Quail Creek: The Birth and Death of a Lake." The Daily Spectrum (January 2, 1989).

[61] Guldan, Rick, and Loren Webb. "Bitterness Surfaces Among Flood Victims: Who Will Pay for Millions in Losses?" The Daily Spectrum (January 3, 1989).

[62] The Daily Spectrum. January 16, 1989.

Clearly, Quail Creek is a watershed of sorts, in that it can be seen as foreshadowing the need for a different approach to water management in the Virgin River basin. Where previous projects, such as Warner Valley and Dixie, had featured large, multi-faceted proposals, Quail Creek, while still a major undertaking, is considerably scaled-down from its predecessors.[63] Where Gunlock Reservoir was supported by an infusion of federal funds, Quail Creek was essentially a homegrown product, paid for with a combination of State loans, local taxes, and consumer's water bills. Most critical, however, is the notion that Quail Creek will almost surely be remembered as the last dam to escape close public scrutiny, and to evade federal laws that require a complete analysis of a dam's potential environmental impacts. Issues of dam safety, threatened and endangered species protection, and the public's role in deciding its water future were all but ignored at Quail Creek. Because of that experience, it is a scenario unlikely to occur again.

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[63] Numerous smaller projects abound. For example, Washington County real estate developer Jim Trees constructed a dam and 1760 af reservoir on the Virgin River East Fork near Zion National Park. The project impounds the entire flow of South Creek for the purpose of providing irrigation to 350 acres of agricultural land. Rusk, Jeanette. "Last Quail Creek Pipe In, Soon to be Carrying Water." The Daily Spectrum (April 3, 1985).

Chapter II

Demands on the Virgin River

The Virgin River has continued to flow almost entirely free while over nine thousand years of human civilization have grown up around it. Human impacts on the river during the vast majority of that time were minimal. Only recently have the river and its dependent resources begun to stagger under the weight of industrial-level water development. As the basin begins a transition from agricultural outpost to urbanizing population center, the river finds itself increasingly asked to provide more and more water, and hence to absorb even more pressure upon its other resources. Further, improved scientific understanding of a healthy river's critical role in protecting and enhancing instream resources, including wildlife and other values, is only now beginning to be understood. The conflict between the myriad, and often inherently opposed, demands will continue, if not intensify, as long as the traditional, unbalanced management approaches of the past remain in place.

Instream Resources

Throughout the history of the American West, *instream uses*--those that can be supported without removing significant amounts of water from a particular stream or river--were generally not regarded by water planners as legitimate uses at all. As the prior appropriation doctrine requires both proof of diversion and the application of that water toward a "beneficial use," instream uses have been all but ignored in the West's water system. As one observer put it, "[w]hile declaring as its central premise that water should go to whomever put it to use first...western water law overlooked the fact that the cutthroat trout, the sandhill crane, and the pronghorn antelope arrived on the scene well before the miner, the rancher, and the homebuilder."[64] Also eligible for addition to that list of instream users would be the streamside cottonwood, the shoreline itself, the natural erosional processes, and the solitary hiker that settles in next to the river to watch a storm come up over the cliffs. In short, the actual prior

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[64] Meyer, Christopher H. Western Water and Wildlife: The New Frontier. National Wildlife Federation (1989) [at 1].

appropriators--those whose demands are indeed "first in time"--have seen their water supplies exploited by those that have come later and claimed the river for their consumptive uses.

An expanding understanding of river systems and their biology, however, has led to increased interest in protecting those resources that require consistent instream flows. Legislation that brings instream uses into the fold of those accepted under the prior appropriation doctrine is now part of several states' water law systems. Further, an ongoing federal study in the Virgin River basin states is working toward developing detailed data regarding the range and health of resources dependent on instream flows, as well as the amount of flow required to ensure at least the minimal protection of those resources. A listing and description of these resources begins below.

Riparian Areas and Wetlands

Riparian areas and wetlands serve a variety of critical needs in the desert Southwest, providing opportunities for recreation, wildlife, and sport fisheries. These zones also tend to feature stable streambanks, vegetative diversity, and healthy channels. They provide the shade necessary to regulate stream temperatures, a critical factor in ensuring the health of native fish populations. Petts, among others, notes also that the myriad resources located in riparian areas depend to no small extent on the existence of natural flows:

> The characteristics of the riparian communities are controlled by the dynamic interaction of flooding and sedimentation. Floodplain and deltaic communities are often characterized by a high degree of primary biological production; by the constant replacement of older soil-vegetation complexes that are destroyed by floods and channel erosion; or by new successional sites which are initiated on ground that is formed by the deposition of sediment during receding flood stages. Floodplain backwaters provide important breeding refuges and habitats for a variety of lotic fauna, and the absence, or curtailment, of flooding limits opportunities for exchanges between the parent river and the floodplain pools and lakes.[65]

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[65] Petts, Geoffrey E. Impounded Rivers: Perspectives for Ecological Management. John Wiley & Sons: New York (1984), at 164.

Of all their values, however, their provision of rich wildlife habitat is perhaps most critical. In Arizona's Strip region, for instance, riparian areas provide some of the richest wildlife habitat available, even though they account for less than one percent of the public lands acreage in the area.[66] These wet areas also are significant contributors to improved water quality and scenic values.

The three Virgin River basin states are working via the BLM's Resource Management Planning (RMP) process[67] toward varying degrees of riparian area protection. According to

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[66] United States Department of the Interior, Bureau of Land Management, Arizona Strip District. Proposed Arizona Strip District Resource Management Plan and Final Environmental Impact Statement [hereinafter Strip RMP] (1990) [at III-17]. The significance of riparian resources is also illustrated by the Dixie Resource Area's statement that "[n]ew policy would give riparian values preference over most other resource values (except for Federally listed T&E species or candidate species." United States Department of the Interior, Bureau of Land Management, Dixie Resource Area. Proposed Dixie Resource Management Plan/Final Environmental Impact Statement [hereinafter Dixie RMP] (n/d) [at 151].

[67] The Federal Land Policy and Management Act (FLPMA) [43 U.S.C. §1701 et seq.], at Section 202, requires the development of land use plans. These plans serve as direction for future resource management decision making regarding everything from habitat protection to off-road vehicle use to minerals development. In the Virgin River basin, three RMPs are in various stages of completion: in Utah, the Dixie RMP is being rewritten for the third time; the Arizona Strip plan has been accepted and is now in force; in Nevada, the Stateline plan is at the draft stage, but with no final plan on the immediate horizon.

WCWCD, in a January 27, 1993 letter to BLM, requested that work on the Dixie RMP be suspended in order to allow completion of, and input from, several local and state planning efforts, including the Utah State Water Plan, Washington County's "buildout" plan, and a WCWCD strategic water development plan.

The latter, according to WCWCD, will not be complete until July 1994. Included in the Strategic Plans are proposals that would remove streams and washes within Washington County from Wild and Scenic River consideration, and that would allow the "full use of prior existing water rights on the Virgin River and its tributaries, including the Beaver Dam Wash." Webb, Loren. "Washington County Officials Seek More Input on BLM Land Strategies." The Daily Spectrum (May 9, 1993).

(continued...)

the most recent version of its RMP, Utah's Dixie Resource Area intends to acquire water rights on almost 60 miles of Virgin River basin stream segments.[68] Other anticipated acquisitions include 30,000 acres in the Beaver Dam West Fork area for water protection and another approximately 3000 acres of riparian lands scattered throughout that section of the basin.[69]

In addition, the proposed Dixie RMP calls for the designation of four riparian Areas of Critical Environmental Concern (ACEC):[70] Santa Clara River/Gunlock (1790 acres), Santa Clara River/Land Hill (1770 acres), Lower Virgin River (1460 acres), and Warner Ridge/Fort Pearce (3690 acres).[71]

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[67](...continued)
In another effort to further delay the Dixie RMP, Utah Representative Met Johnson sent, on March 15, 1993, a letter to Dixie Resource Area Manager Debbie Pietrzak requesting that the scoping and public review segments of the RMP process be reopened. In her response of March 26, Pietrzak stated that BLM would not comply with Johnson's request, and noted that "it would not be appropriate to delay the [Dixie] RMP at this time."

However, SUWA has since learned that various aspects of the RMP--including, notably, the wild and scenic rivers evaluation--will in fact be opened to an "unofficial" public comment process. Interview with Margaret Kelsey, Outdoor Recreation Planner, Utah BLM State Office, May 19, 1993. It remains unclear whether or not BLM will allow local and county interests to continue to dictate the timeline for eventual release of the Dixie RMP.

[68] Dixie RMP, at 117-118.

[69] Dixie RMP, at 119-120.

[70] Areas of Critical Environmental Concern, and protective management schemes for those areas, are identified via the RMP process. See 43 CFR §1610.7-2. To receive designation as an ACEC, an area must present a "significant historic, cultural, or scenic value; a fish or wildlife resource or other natural system or process; or natural hazard." 43 CFR §1610.7-2(a)(1).

It should be stressed that the designation of ACECs is an administrative determination only--there is no statutory protection afforded these areas. Thus, ACEC status should not be confused with the more stringent protections offered by other land-use designations.

[71] Dixie RMP, at 127.

The Strip District RMP includes continued management for riparian and scenic values in the 8100-acre Virgin River Gorge ACEC.[72] Twenty-nine miles of the Virgin River, along with 50 acres of Beaver Dam Wash, are included in the RMP's "priority riparian area" list.[73] The RMP Implementation Plan for the Shivwits Resource Area further designates the Virgin's bottomlands from the Utah border to the Nevada border as a riparian ACEC in order to protect endangered fish, scenic values, wild and scenic river potential, and recreation values.[74] Like the Dixie plan, the Shivwits plan recommends the acquisition of any non-federal lands along the Virgin River corridor that contain riparian values.[75]

Though Nevada's segment of the Virgin boasts about 195 acres of riparian resource on BLM land,[76] the Stateline District's Draft RMP is vague on the subject of riparian area protection. According to the RMP, however, BLM is considering designating part of the Virgin River corridor as an ACEC to protect riparian resources and endangered species populations.[77]

Sensitive Fish Species

Instream flows in the Virgin River support at least three sensitive native fish species: the woundfin minnow, the Virgin River chub, and the Virgin River spinedace. Some nine other "scientifically critical" fish, including the flannelmouth sucker, the desert sucker, and the Moapa

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[72] Strip RMP, at A-20.

[73] Strip RMP, at Table III-13.

[74] United States Department of the Interior, Bureau of Land Management, Shivwits Resource Area. Implementation for the Arizona Strip District Approved Resource Management Plan [hereinafter Shivwits Implementation Plan] (1992) [at 20].

[75] Shivwits Implementation Plan, at 20.

[76] Stateline RMP, 3-24.

[77] Stateline RMP, at E-8. Note that the size of the potential designation is unspecified. An ACEC map included in the RMP's Appendix (at 2-20, 2-21) shows the potential ACEC as occupying the north side of the river, and extending from the Arizona state line to the boundary of Lake Mead NRA.

spinedace, also depend to some extent on Virgin habitat.[78] Fish habitat in the Virgin River basin has changed dramatically since the 1960s. At one time, some 75 miles of the river provided habitat for native species. That range has been whittled down to about 20 miles.

Also of critical concern is the fact that populations of these sensitive species were abundant as little as twenty years ago.[79] The U.S. Fish and Wildlife Service has on several occasions indicated its concern with declining native fish populations. Correspondence beginning in the mid-1980s notes that "Woundfin Recovery Team[80] monitoring data showed an 86 percent decline in native fish populations between October 1986 and October 1987. Subsequent surveys indicate that native fishes declined an additional 11 percent since October 1987, relative to 1986 levels.[81] FWS concerns about the woundfin and Virgin River chub led to the inclusion of both species on the Endangered Species list, and the Recovery Team's finding that

> [t]he woundfin and Virgin River chub were listed due to their localized distributions, loss of significant portions of historical range and deterioration of much of the remaining habitats, both largely through construction of dams and diversions, and the introduction of exotic species within their remaining habitats.[82]

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[78] Interview with with W.L. Minckley, Professor of Biology, Arizona State University, Tempe, Arizona, January 12, 1993.

[79] Minckley interview.

[80] The Woundfin Recovery Team--now known as the Native Fish Recovery Team--is composed of representatives from environmental, scientific, public agency, and local political interests, and is charged with developing policies to protect and recover native fish populations in the Virgin River. The Recovery Team was first formed in August 1975 to address the recovery of the woundfin minnow. Its charge was expanded in 1990 to include study and recovery efforts on behalf of the Virgin River chub.

[81] Letter from John L. Spinks, Jr., Deputy Regional Director, United States Fish and Wildlife Service/Denver, to Duane L. Shrouf, Arizona Department of Game and Fish, December 7, 1988.

[82] United States Department of the Interior, Fish and Wildlife Service. Draft Virgin River Fishes Recovery Plan [hereinafter Recovery Plan] (1992) [at 13].

A third fish, the Virgin River spinedace, is currently under consideration for addition to the T&E list. Fish and Wildlife Service, in its Federal Register notice describing the decision to pursue listing of the spinedace, stated that

> [t]he major factors that have contributed to the decline of the Virgin spinedace include flow depletion/dewatering, water diversion, habitat fragmentation, increased sedimentation, degraded water quality, and invasion by nonnative species.[83]

Clearly, native fish populations, and the Virgin River's ability to support them, are deteriorating due to a combination of water development, continued agricultural consumption, and the impacts of introduced species. Strategies to address their declining numbers, and to formulate some process for protecting suitable habitat, are--as will be seen--failing to evolve at the pace needed to meet the mandates requiring the species' protection.

Woundfin Minnow

The woundfin minnow[84] (*Plagopterus argentissimus*) was designated as "endangered" and placed on the endangered species list in 1970.[85] The woundfin's historical distribution ranged from Utah's LaVerkin Creek into Nevada, as well as the Colorado mainstem in Arizona and several other southwest rivers, including the Salt, the Verde, and the Gila.[86] Dambuilding--six are in place on the Salt/Verde complex and two on the Gila--have cut off natural flows and thus eradicated most woundfin habitat there. A series of dams and reservoirs on the Colorado have likewise eliminated woundfin from that river.

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[83] United States Department of the Interior, Fish and Wildlife Service. Notice of 90-Day Finding on Petition to List the Virgin River Spinedace as Endangered. 58 Federal Register 14169 [hereinafter Spinedace Finding] (March 16, 1993) [at 14170].

[84] The woundfin is a scaleless, silvery, minnow-like fish with a flat head and sharp dorsal spine. The species grows to a maximum of 3 inches. It is adapted to swift and shallow sand-bottomed streams, though juveniles will often collect in slower and deeper stream reaches. Woundfin tend to congregate in turbid waters, avoiding stream sections where water clarity is high in order to limit exposure to bird predation. Recovery Plan, at 2-3.

[85] 35 Federal Register 16047, October 13, 1970.

[86] Recovery Plan, at 3.

Present distribution has been reduced to the Virgin mainstem from LaVerkin down to Lake Mead, with perhaps the most productive habitat existing at the confluence of the Virgin with Beaver Dam Wash in Arizona.[87] Virgin River woundfin habitat, however, has been radically degraded. The filling of Lake Mead destroyed habitat at the lower end of the river, while the alteration of streamflows for consumptive purposes has resulted in lost habitat further upstream. The Recovery Team determined in 1985 that

> [t]he major limiting factor for woundfin today is modification and loss of habitat. The building of dams and associated reservoirs, water diversion structures, canals, laterals, aqueducts, and the dewatering of streams, are the main contributors to this problem. The introduction and spread of exotic fish species also appears to have had a negative impact on the species. With the human population increase in the desert southwest, the loss of woundfin habitat will surely continue unless protective measures are developed and implemented.[88]

Virgin River Chub

The decision to add the Virgin River chub[89] (*Gila robusta seminuda*) to the endangered species list was made in 1989.[90] Virgin River chub populations have always been limited to the mainstem Virgin. Though it once ranged from Pah Tempe Springs in Utah to the Virgin's confluence with the Colorado River, the Virgin River chub is now found only on the stretch of

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[87] Strip RMP, at III-16.

[88] United States Department of the Interior, Fish and Wildlife Service. Recovery Plan (1985) [at 10]. Unfortunately, little has changed regarding the content of the threats to woundfin and its habitat. The Recovery Plan now under review contains essentially the same language as the plan prepared some eight years ago. Recovery Plan, at 11.

[89] Like the woundfin, the Virgin River chub is a silvery minnow. It tends to be larger--about 8 inches long--and prefers slower stream runs than does the woundfin. Chub will tend to congregate in areas with cover, such as boulders or root snags. Recovery Plan, at 9.

[90] 54 Federal Register 35305, August 24, 1989. The final listing decision was published more than two years after the original notice [see proposed rule at 51 Federal Register 22949 (June 24, 1986)].

river from Pah Tempe to the Mesquite Diversion in Nevada.[91] Despite their diminished habitat--and the requirements of federal law--five years have passed without designation of critical habitat[92] for the fish.

Fish biologists' explanations for the continued decline of the chub are almost identical to those for the woundfin. The Fish and Wildlife Service's draft environmental assessment addressing the proposal to list the chub was blunt in its language regarding the problems faced by the species:

> The major reason for declines in Virgin River chub populations is habitat destruction. The inundation of the lower Virgin River by Lake Mead and the dewatering of several other sections of the river have caused most of the habitat loss...Deeper habitats are generally lost with reduced or intermittent flows as the scouring and substrate transport capabilities are lowered, causing filling in of deeper areas in sandy substrates [citation omitted]. [Other researchers have] suggested several other factors such as competition and predation by introduced fishes, disease and parasites, and pollution as potential reasons for the chub's current status...Further habitat degradation, especially through dewatering, could have disastrous effects on remaining chub populations.[93]

Virgin River Spinedace

A third sensitive native fish species, the Virgin River spinedace[94] (*Lepidomeda mollispinis mollispinis*), was until recently listed as a "Category II" (C2) species, meaning that

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[91] Only a limited number of individuals have been collected below Mesquite Diversion since the 1970s. Recovery Plan, at 9.

[92] "Critical habitat" are those geographic areas containing physical or biological features essential to the conservation of a species listed under the ESA. See Endangered Species Act, 16 U.S.C. §1533(a)(3).

[93] Holden, Paul B. Draft Department of the Interior Environmental Impact Assessment: Proposed Determination that the Virgin River Chub is an Endangered Species. Bio/West, Inc: Logan, UT (n/d) [at 7].

[94] The spinedace is a scaly minnow, mostly silver with blotches of reddish-orange on the fins; the head is rounded. Unlike both the woundfin and the chub, the species prefers clear, cool streams composed of a combination of riffles, pools, and runs. They are therefore more suited to the tributaries of the Virgin, rather than to the mainstem itself. Valdez, Richard A. et al. Status of the Virgin River Spinedace in the Virgin River Drainage, Utah. Bio/West, Inc.: Logan, UT [hereinafter Valdez Report] (1990) [at 4].

the federal agencies did not possess enough information about the species, or the possible threats to it, to make a listing decision. However, a petition to add the spinedace to the T&E list was forwarded to FWS on June 15, 1992. The Service has since issued a 90-day finding determining that "the petitioners presented substantial information indicating that the requested action to list the fish as endangered may be warranted."[95]

Spinedace populations historically stretched from the Virgin East Fork into Nevada. However, spinedace populations have been extirpated in several areas, including Utah's Quail and Leeds creeks.[96] Populations of varying strength are now found in several tributaries and subtributaries of the Virgin River: Beaver Dam Wash, Santa Clara River/Moody Wash, Ash Creek, LaVerkin Creek, North Creek, the North and East Forks of the Virgin, and Shunes Creek. Its viable habitat has been reduced by 40%, from 144 to 87 river miles.[97]

Valdez was able to locate signs of thirteen spinedace populations: three have been extirpated from their habitat, another three are in good shape but threatened, six are in decline with persistent threats, and one (the Santa Clara River population) is showing rapid decline and is thus in danger of extirpation. None of the remaining ten populations are considered free of human threats, which, according to Valdez, include loss of habitat, competition from non-native fish, dewatering from diversions and dams, habitat alteration due to livestock and agriculture, existing and impending water development, water degradation from agricultural and municipal developments, and the inundation of habitat by reservoirs.[98]

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[95] 58 Federal Register 14169, March 16, 1993.

[96] Valdez Report, at iii. Due to the general lack of information regarding the spinedace, all distribution data is from this source. The Arizona Strip BLM RMP notes, however, that spinedace range is limited to the tributaries, as well as to the Virgin mainstem at the mouth of the tributaries in Utah and Arizona. Strip RMP, at III-16.

[97] Valdez Report, at iii.

[98] Valdez Report, at iii.

Overall, trends for native fish survival are bleak.[99] Available habitat continues to shrink as water managers respond to the pressures of increased urbanization with plans to further develop the river via structural approaches. Deacon is particularly pessimistic:

> It is apparent that current utilization practices of the water resources [on the Virgin] permit survival of the native fishes in about 29 percent of their remaining potential habitat. Intermittent flows coupled with higher summer temperatures throughout the remainder of the potential range [citation omitted] make it unreliable as a fish habitat. Within the remaining 29 percent of the potential

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[99] Native fish populations are indirectly impacted by water development as well. Heckmann et al. notes that woundfin and other Virgin River fishes are increasingly at risk to parasitism, particularly in agriculturally-disturbed areas where flows are reduced, where ponded conditions tend to exist, and where return flows tend to be of poor quality. Heckmann, Richard A., James E. Deacon, and Paul D. Greger. "Parasites of the Woundfin Minnow and Other Endemic Fishes from the Virgin River, Utah." 46 Great Basin Naturalist 622 (October 1986) [at 665 and at 674]. Parasitism often results in reduced egg production, as well as other changes in fish behavior and growth, Id, at 662.

Tapeworm infections are also becoming more prevalent in the Virgin's native fish. A review of the data indicates that infection rates worsen in those areas reflecting greater habitat disturbance, Id., at 674.

Another result of dams and diversions is seen in changes to the river's natural characteristics. Deacon et al. notes that "[i]n recent years, agricultural, municipal, and industrial water uses in arid regions of the southwestern United States have reduced both stream flows and water quality. The consequent alterations in thermal, chemical, and flow regimes, coupled with the discharge of various effluents and the introduction of non-native fishes, have seriously reduced many native fish stocks." Deacon, James E., Paul B. Schumann, and Edward L. Stuenkel. "Thermal Tolerances and Preferences of Fishes of the Virgin River System (Utah, Arizona, Nevada)." 47 Great Basin Naturalist 538 (n/d) [at 538].

Finally, the astounding expansion of exotic populations--apparently caused by the fish being introduced to reservoirs as bait or simply being dumped--in the Virgin has significantly affected native fish viability. Only four red shiner were collected in the Virgin River near St. George in 1984. Just two years later, red shiner was the most abundant species in that reach of the river. Recovery Plan, at 11. Numerous plans to address the red shiner problem have been formed; some have ended in disaster, such as the rotenone poisoning of 1988 that killed hundreds of natives and exotics alike when agency officials failed to control the spread of the poison far downstream of the intended application area.

habitat, reproduction occurs during years of normal flow, but is extremely poor to absent during years of low flow. *This circumstance suggests that at present the fishes are living in a habitat which has extremely little potential for further development or alteration without adverse impacts on the endangered species present.*[100]

Other Sensitive Species

In addition to the sensitive fish species discussed above, a variety of other wildlife and plants in the Virgin River basin are included on federal and/or state endangered species lists.[101] Many of these species are directly dependent on the Virgin and its related resources for survival. For example, American bald eagles utilize riparian vegetation along the Virgin, especially mature cottonwoods, for winter roosting sites. The health of a number of C2 species, such as the leopard frog, may also be related to the availability of instream flows in the Virgin River.

Unfortunately, research on many of these populations is lacking. The most recent leopard frog survey, for example, which the Utah Division of Wildlife Resources performed in 1984, found populations in several springs near the Virgin. However, no funds for updating research have been made available since. Knowledge about the species is essentially limited to its habitat preference; there is no data on reproduction, nor on the threats presented by development, by mosquito control and insect abatement programs, and so on.[102]

Recreation And Aesthetics

The Virgin River's ability to provide for recreation and for a pleasurable aesthetic experience is an important part of the demand mix. Those characteristics that translate into a positive recreational or aesthetic experience, such as consistent flows, vibrant riparian areas, or fully functioning wildlife habitats, are fundamental indicators of overall river health. A "wild"

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[100] Deacon, James E. "Endangered and Threatened Fishes of the West." Great Basin Naturalist Memoirs, No. 3 (1979) [at 48] (emphasis added).

[101] See Figure 8. Compiled from Dixie RMP, Strip RMP, and Stateline RMP.

[102] Interview with David Ross, Utah Division of Wildlife Resources herpetologist, Salt Lake City, Utah, January 20, 1993.

river--one free of human impacts and influences to the greatest extent possible--is in the truest sense best able to meet human demands for instream flows.

Additionally, recreational uses can often be of high economic value. Opportunities for boating or fishing, for example, will attract visitors and, thus, tourist dollars to riverside communities. Studies that have focused specifically on the value of instream flows in this sector have determined that the recreational value of instream flows can in many instances exceed the value of water used out-of-stream for irrigation and other applications.[103]

Historically, water managers in the West have allocated to instream uses only that "leftover" water not demanded by the municipal and industrial sector (M&I) and agricultural sectors. Emerging interest in the many values of instream flows, though, is leading to more frequent implementation of the many strategies available to protect instream flows and related resources.[104] The growing understanding of the need to protect these flows, however, is often eclipsed by the perceived needs of traditional water planning and decisionmaking on the Virgin River. These traditional uses and institutions are described in the next two sections.

Municipal and Industrial Sector

As urbanizing communities undergo the transition from agricultural-based economies, their water requirements change significantly. In addition to the need for high-quality culinary water for an expanding population, these communities need water to meet other demands, including those of new industry, of new infrastructure improvements such as schools and hospitals, and of other household needs like laundry, air conditioning, and lawn watering. These uses constitute the M&I sector.

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[103] A summary of recreation value studies is provided in Saliba, Bonnie Colby, and David B. Bush. Water Markets in Theory and Practice. Westview Press: Boulder, CO (1987) [at 222]. Additionally, MacDonnell posits that the value of recreation-related water--estimated at $700 to $1100 per acre-foot--far exceeds that for irrigation ($40/af), household uses ($200/af), or power production ($600/af). MacDonnell, Lawrence J. "Shifting the Uses of Water in the West: An Overview." In Moving the West's Water to New Uses: Winners and Losers. University of Colorado Law School: Boulder, CO (1990) [at 8].

[104] These strategies are discussed in Chapter V.

The amount of water required to fulfill needs in the M&I sector is primarily related to (1) the population of a particular water service area and (2) the number and type of industries in that service area. Other factors, such as evaporation rates, delivery system efficiency, water conservation measures in place, water use habits of new residents, and so on will also influence the amount of water the sector requires.

Several communities in the Virgin River basin are currently witnessing unusually rapid population growth. Paralleling that growth is the expected expansion of demand for additional M&I water. Water planners are thus faced with the difficult task of determining how that demand will be met--first, by projecting future population levels and, second, by making assumptions regarding future water needs. These two projections will in turn drive, to no small extent, the strategies needed to ensure the provision of that water. Clearly, the accuracy of both the population projections and of the assumptions in place regarding future water needs are critical.

Washington County, Utah

The most explosive growth in the basin is underway in the communities of Washington County, Utah. The county itself roughly doubled in population during the 1980s.[105] Projections from the State of Utah's Office of Planning and Budget (OPB) call for continued steady increases through the year 2020. According to OPB, Washington County could see a population of some 130,000 by that year.

WCWCD data assumes even greater growth in southwest Utah, finding in one study that the county's population could approach 700,000 by the year 2030.[106] The Conservancy

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[105] Washington County's population grew from 26,065 to 48,560 during the 1980s. Utah Office of Planning and Budget. State of Utah Economic and Demographic Projections 1992 (1992).

[106] See Figure 9. This graph, developed and distributed by WCWCD, is a crude attempt to link Washington County's growth rate to that of Las Vegas. The graph shows Washington County's population reaching more than 700,000 by 1990, demonstrating WCWCD's assumption that Washington County is growing at rates equivalent to Las Vegas. It also demonstrates a willingness to invite the assumption that Las Vegas and Washington County are "competing" for Virgin River water.

District is preparing a "buildout study"--an attempt to determine what the ultimate population of the county could be, given current and projected growth rates, available property, and so on. While the study is still in its early stages, WCWCD has made no secret of the fact that it considers existing growth figures, particularly those produced by OPB, to be unrealistically low. Ron Thompson, WCWCD General Manager, recently stated that OPB's assumption of a steady three percent growth rate to the year 2020 may be too low, given the current actual rate of six percent--implying an expectation on his part that the county will continue growing at recent, albeit record-setting, levels.[107] Disagreements between various planning entities regarding future population levels is but one obstacle in the task of planning for the county's water future.

The county's largest municipality, St. George, likewise saw its population more than double in the last decade, increasing from 13,146 in 1980 to 28,502 in 1990.[108] Both state and local planning agencies, furthermore, expect this population boom to continue. The Five County Association of Governments (FCAoG), a Utah planning entity that includes Washington County in its membership, projects that St. George's population will soon redouble, reaching almost 60,000 by 2020. OPB, in figures developed for Utah's Draft Virgin River Basin Water Plan, assumes slightly faster growth, with St. George exceeding 70,000 residents by 2020.[109] Most striking, however, are the expectations of the City of St. George, which in its own buildout study recently projected that the city could, by some unspecified date, be home to as many as 250,000.[110]

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[107] Webb, Loren. "It Could Get More Crowded Than You Think." The Daily Spectrum (December 17, 1992).

[108] Washington County Water Conservancy District. Washington County Populations and Projections (1992). The current population, according to the City of St. George, is about 35,000.

[109] See Figure 10. OPB figures are from Utah State Water Plan, at 4-3. FCAoG figures are from United States Department of Agriculture/Soil Conservation Service, and Utah Department of Natural Resources/Division of Water Resources. Virgin River Basin-Utah Cooperative Study (1990) [at 5].

[110] "Study: St. George Could have 250,000 People." Cedar City Spectrum (April 16, 1993).
(continued...)

The numerous towns scattered around Washington County are also exhibiting strong growth rates, though their populations are still relatively small. The community of Santa Clara, for example, is now home to 3100 people, up from 2322 in 1990 and 1091 in 1980. Town planners expect that, with the approval of a proposed subdivision, Santa Clara's population could jump to 3400 by 1995, and to more than 6000 by the turn of the century.[111] Cedar City, the largest town in neighboring Iron County--and a potential user of Virgin River water--also is poised for significant growth.[112]

A locally-produced promotional publication describes one possible future for St. George with breathy excitement and, in doing so, addresses a potential problem for that future:

> The city continues to grow at rates that would astonish the most ardent promoter of twenty years ago. And the search for more...water will continue as long as people continue to choose St. George for their home.[113]

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[110](...continued)

The St. George study purports only to determine the "carrying capacity" of the property in the city's land base; that is, the maximum number of people that could inhabit the acreage available for homebuilding in the area. The plan makes no attempt to determine how infrastructure needs, water supplies, etc. would be met. Nor does the document discuss the impacts of such growth on the region's quality of life and environment. Interview with Wayne MacArthur, City of St. George, April 17, 1993.

[111] James, Lyle. "Santa Clara Has Its Eye on Clean Industry." The Daily Spectrum (January 4, 1993).

[112] See Figure 11. Utah Department of Natural Resources, Division of Water Resources. Investigation of Transbasin Diversion From Upper Virgin River Basin to Cedar City [hereinafter Cedar City Transbasin Study] (1988) [at 8].

A report prepared for Cedar City by Bingham Engineering of Salt Lake City cites substantially higher population projections for the region, e.g., 27,776 by 2020, as compared to the 23,310 projected by the Transbasin Study. The source of Bingham's projections is not cited in the evaluation; however, Bingham does note that "the population projections shown...may be underestimated based on recent growth and development in Cedar City." Bingham Engineering, Inc. Evaluation of Water Supply, Water Demand, and Water Development Opportunities for Cedar City [hereinafter Cedar City Evaluation] (March 1993) [at I-6].

[113] Making the Desert Bloom, at 64.

A consequence of these astounding population increases--or, for that matter, of any population increase--is of course increased demand for M&I water. WCWCD expects its service area's needs to roughly triple over the next twenty years, growing from just over 15,000 acre-feet annually to over 45,000 acre-feet per year.[114] County-wide figures contained in the Utah Water Plan call for a slightly slower expansion in demand, but still expect a significant increase from the current 19,500 acre-feet to more than 90,000 acre-feet by 2040.[115]

Water planners in St. George and other Washington County communities expect M&I demand to follow the same steep curve. The Utah Water Plan envisions public water use in the region's largest town to grow from the current 13K acre-feet to almost 34K acre-feet by 2020, with slower rates of expansion in neighboring locales.[116]

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[114] See Figure 12. Washington County Populations and Projections, at 3. Note that these water demand figures are based on population growth projections far less than the 700,000 figure stated by WCWCD in other documents.

[115] Utah State Water Plan, at 11-7.

At a July 2, 1993 meeting of Virgin River water interests, the Division of Water Resources released updated figures for current and projected water use in Washington County. The new figures are organized somewhat differently. For example, "secondary" uses--that is, the use of non-treated or non-potable water for golf courses, parks, cemetaries, and many outdoor household uses--are now categorized separately from "irrigation" uses.

Figures presented in the July 2 release for both current and projected water use levels were likewise adjusted. M&I diversions were generally adjusted down from initial projections, yet depletions were projected to actually increase. Water diverted for use in the new "secondary" category is projected to rise from the 1990 level of about 15,000 acre-feet to almost 62,000 acre-feet by 2040; depletions, which are assumed to be 80% of the water diverted, rise from 12,000 acre-feet to almost 50,000 acre-feet.

However, the July 2 figures will again be modified prior to the release of the final Utah State Water Plan, as a further review of water use in Washington County has already made these figures obsolete. Conversation with Eugene Bigler, Utah Divsion of Water Resources, July 22, 1993.

[116] See Figure 13. Utah State Water Plan, at 11-8.

As is the case regarding population projections, assumptions about future water needs in the sector vary widely. Logically, the use projections noted above should attempt to quantify assumptions about future water use practices on a per capita basis, and thus should factor in the effects of future water conservation measures, improved delivery systems, changing water use habits, and so on. However, the accuracy of these particular data is questionable, as it is unclear what, if any, policy changes regarding water use were included in their development. What is known, however, is that per capita rates of water use in many of the Utah communities of the Virgin basin are much higher than those in other parts of Utah, or in the nation as a whole. Water projections based on current use rates, of course, will be much higher than projections which would account for water-saving measures. While the draft Utah State Water Plan makes its projections based on current use rates, it is expected that the final version of the plan will include assumptions about future water conservation programs.[117]

The Arizona Strip

At least for the time being, population issues in the Strip region of Arizona are not as critical as those in Utah, as there are no major metropolitan areas in this reach of the state. There are, however, still significant demands for water in the M&I sector, centered primarily in the towns of Littlefield and Beaver Dam.

According to figures developed by the Arizona Department of Water Resources (AZDWR), general domestic demand in 1990 was 213 acre-feet, or 250 gallons per capita day (GPCD) for the region's population of 762. Domestic consumption accounted for 1.4% of the total water demand in the area. Water applied to golf courses accounted for another 1944 acre-feet, assuming 6 acre-feet per acre on 324 acres--about 12.6% of the total use. So-called "miscellaneous" uses, including fire protection, construction and so on, required another 432 acre-feet, or 2.8% of total demand.[118]

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[117] See Figure 14 for current water use rates. Utah State Water Plan, at 5-25.

[118] Barrios, Frank, Arizona Department of Water Resources. From a presentation to Virgin River researchers, Phoenix, AZ, January 11, 1993 [hereinafter "Barrios presentation"]. (continued...)

AZDWR projections for the year 2040 are based on a number of assumptions, including the construction of four to six new golf courses, success in the region's attempts to attract light industry, a near-tripling of residential population, and the implementation of water conservation measures. With these changes, domestic demand is expected to increase to 748 acre-feet (2225 people at 300 GPCD each), golf course needs to 9144 acre-feet (1524 acres at 6 acre-feet per acre), and miscellaneous uses to 1978 acre feet. In terms of each area's increase as a percentage of total water use, golf courses show a rather large increase in demand--from less than 13% of the total use in 1990 to about 37% fifty years later. Overall M&I demand is expected to increase by over 250% by 2040.[119]

Clark County, Nevada

Like Washington County, much of Clark County, Nevada is undergoing tremendous growth. This is due primarily to the recent rapid expansion of Las Vegas, which, in the course of the 1980s, saw annual growth rates ranging from 3% to 12%. Researchers at the University of Nevada-Las Vegas anticipate continued 2% growth between 1990 and 2030, with the region's population eventually approaching 1.8 million.[120] A recent census, which included populations in nearby Nye County, Nevada and Mohave County, Arizona, put metropolitan Las Vegas's

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[118](...continued)
The bulk of current water demand in the Arizona Strip is for agricultural use.

The "miscellaneous use" figure is derived using an estimated rate of 20% of all non-agricultural uses.

[119] See Figure 15 for data on domestic, golf, and miscellaneous uses. Barrios presentation.

[120] Woodward-Clyde Consultants, Dames & Moore, and Las Vegas Valley Water District. Environmental Report of the Virgin River Water Resource Development Project, Clark County, Nevada. Cooperative Water Project Report #2 [hereinafter LVVWD Environmental Report] (1992) [at 2].

See also Figure 16 for Clark County and LVVWD service area population projections. University of Nevada-Las Vegas Center for Business and Economic Research. Clark County Population Projections (1992) [at 30, 33].

population at just over 925,000. This represents an increase of 465,000 since 1980, making Las Vegas the fastest growing metropolitan area in the country.[121]

At the current rate of 350 GPCD, Las Vegas will soon demand upwards of 1900 acre-feet of M&I water daily. Water from the Colorado River now meets about 85% of the need in Las Vegas, with the remaining demand being filled by groundwater. However, known supplies of groundwater are now fully appropriated; and, given growth projections, the state's portion of the Colorado will be fully utilized by the year 2007.[122] In order to meet new demands, the Las Vegas Valley Water District (LVVWD) has announced plans for its Cooperative Water Project, which would import water from the rural counties of eastern and central Nevada, as well as effect a transbasin diversion of some 70,000 acre-feet annually from the Virgin River.

While nowhere near the sheer size of Las Vegas, the town of Mesquite, Nevada is also demonstrating a propensity for rapid growth. Mesquite's population increased from 922 in 1980 to over 2110 in 1993, making it the second fastest growing city in the state. Housing starts have increased 500% percent since 1985.[123]. The State of Nevada expects Mesquite to reach a population of 5000 by the turn of the century.[124]

Wellwater--approximately 10,000 gallons per month per household--is utilized to meet residential demands in Mesquite.[125] There is also the expectation that Mesquite will share in

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[121] "Las Vegas Population Grows, With Some Help." The Daily Spectrum (January 27, 1993). Note that the 1980 census did not include Nye or Mohave counties.

[122] LVVWD Environmental Report, at 3.

[123] Mesquite, City of. Mesquite, Nevada's Rising Star. St. George Magazine: St. George (1991) [at 8]. See also Nevada Department of Taxation. Population of Nevada's Counties and Incorporated Cities (October 30, 1991).

[124] Mesquite, Nevada's Rising Star, at 6.

[125] City of Mesquite, Nevada. Community Review: A Review of Economic, Demographic and Social Indicators of the City of Mesquite, Nevada (1992) [at 6]. According to figures in the same report, winter daily demand is about 250 GPCD, and summer demand about 475 GPCD. These figures are of little utility, however, as the report fails to define what uses are included in those demand figures.

the water generated by LVVWD's proposed Cooperative Water Project, should that project ever be realized.[126]

Meeting M&I Demand

Plans formulated to address current and projected M&I needs in the communities of the Virgin River basin tend to focus almost exclusively on structural approaches to water management; that is, on the construction and operation of dams, diversions and reservoirs. Since much of the Virgin's water is not adequate for M&I purposes unless treated, there is also a significant amount of groundwater use. Approaches not requiring on-the-ground changes to the river, such as demand reduction or appropriate water pricing policies, generally do not play a significant role in policies set by water planning institutions in any of the three states.

Water planning entities, such as WCWCD, LVVWD, and the various state departments of water resources, have placed water development for M&I purposes on a treadmill of sorts. Recent experience has demonstrated that increased consumer demand, whether it arises via population growth, industrial expansion, or changes in personal lifestyles, is usually greeted by an institutional call for additional structural programs, often on waterways already overtapped for those purposes. Once constructed, the additional capacity yielded by these projects may obviate incentives to limit growth or otherwise reduce demand. A case in point is the Utah State Water Plan, which makes no secret of the State's interest in increased structural development in the region:

> There is a need to build additional water storage facilities in order to provide for projected needs and demands...The Washington County Water Conservancy District, Kane County, and other appropriate entities should take the lead to protect and reserve potential water storage sites for future use.[127]

The Plan also expects that

> [t]he water development required to meet future needs will come by way of several sources. These include developing both surface water and groundwater

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[126] LVVWD Environmental Report, at 5.

[127] Utah State Water Plan, at 9-27.

> rights, operating existing reservoirs to produce the highest possible yield, building new reservoirs, converting agricultural water to M&I uses, and conservation programs. Also, seeking modification of instream flow requirements and applying for additional groundwater rights have possibilities.[128]

Again, of importance here is the obvious bias toward structural approaches. Though the language would seem to reflect an interest in conversion and conservation--that is, in non-structural approaches--the fact remains that these alternative strategies for meeting demand receive only limited attention in the actual plan.

The above is not meant to imply that Utah alone is guilty of tunnel vision as regards approaches to meeting water demand. Water planning entities in Las Vegas have likewise declared their intent to meet the challenge of providing water to almost two million people by investing in the Cooperative Water Project, a huge undertaking that would combine traditional dambuilding with construction of a desalinization plant and a substantial network of pipelines and pumps across the desert landscape.

As continued population growth in the Virgin River basin is apparently accepted as a given, there is ongoing pressure from water planners to further develop the river's yield. This is done in the absence of any review of current water policy direction, and ignores the harder questions regarding reasonable limits to growth, water demand, and so on. The habitual dependence on structural approaches only delays a more rational approach to allocation of the river. Given the limited resources available from the Virgin, increasing demand, coupled with the obsolete responses usually formulated to address that demand, can only drive the river beyond its ability to meet the needs of its various dependents.

Agricultural Sector

The agricultural sector is made up of those uses related to the operation of farms, with "farms" defined as businesses realizing at least $1000 in sales of agricultural products

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[128] Utah State Water Plan, at 11-9.

yearly.[129] Such uses would include water for irrigation and sprinkler systems, water for livestock uses, and so on. Overall, water use in the Virgin River basin's agricultural sector is no less plagued by a combination of poor management and institutionalized incentives to waste water. Perhaps more disturbing is that water dedicated to use in the agricultural sector is ultimately of far less value per unit of volume than is water applied to the M&I sector.

Utah's agricultural sector is by far the largest in the basin. Livestock production, both for beef and dairy, has traditionally been the area's mainstay operation.[130] Total irrigated land in Washington County is approximately 17,000 acres,[131] a great deal of it served by several private irrigation companies tapping Virgin River water. The preponderance of irrigated lands in the region are dedicated to pasture and alfalfa production.[132]

Southwest Utah's agricultural sector, like its M&I sector, is undergoing a significant transition. Changes in the livestock market and the growing urbanization of the area are but two factors changing the look and the tradition of the region's farming economy. The FCAoG notes that "Intensive farming activities such as dairying are decreasing, [while] more passive activities such as hay production and livestock grazing are increasing."[133] Such farms provide few employment opportunities. OPB projections regarding agricultural employment in Washington

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[129] United States Department of Agriculture/National Agricultural Statistics Service, Utah Agricultural Statistics Service, and Utah State Department of Agriculture. 1992 Utah Agricultural Statistics (1992) [at 22]. Prior to 1975, "farms" were defined as those businesses occupying 10 or more acres with annual sales of agricultural products of $50 or more, or businesses of less than 10 acres with sales of $250 or more. Note that agricultural products are limited to crops and/or livestock, and do not include fertilizers, farm implements, etc.

[130] See Figure 17. Cooperative Study/Cropland, at 8.

[131] Utah State Water Plan, at 10-10.

[132] See Figure 18. Utah State Water Plan, at 10-10.

[133] Memorandum from Kenneth Sizemore, Director of Community and Economic Development, Five County Association of Governments, to Clayton Ramsay [hereinafter Sizemore Memo] (May 11, 1989).

County are essentially flat.[134] Projections of the sector's job creation performance relative to other employment areas, such as services and trade, are even more dismal.[135] Another illustration of the impact of agriculture's switch to low-value crops is found in the number of farms operated on a part-time basis; that is, by owners also employed at a job off the farm. That number rose dramatically--from 216 to 277--in the years between 1978 and 1987.[136]

The emphasis on fodder crops, coupled with the increase in part-time farming operations, has worked to change the face of much of southwest Utah's farm sector. Regarding the former, the value of annual sales on a farm-by-farm basis is generally low. Forty percent of the farms in the Utah portion of the basin each generate less than $2500 sales yearly; another 30% are in the $2500-to-under $10,000 category. Only 15% produce more than $25,000 in sales.[137] Additionally, the sheer size of farms indicates a departure from large-scale agriculture. Some 22% of Washington County's farmers occupy less than nine acres of land, with another 22% holding between ten and forty-nine.[138]

These figures reflect the fact that agriculture is, at least in southwest Utah, a low-value, low-employment venture. Trends in the sector show average farm size decreasing, total cropland and harvested cropland decreasing, and the number of farmers working off-farm increasing.[139] Washington County is thus seeing the rapid conversion of its agricultural sector to a "hobby farming" industry that is in turn becoming less and less a factor in the overall

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[134] See Figure 19. State of Utah Economic and Demographic Projections 1992, at 330.

[135] See Figure 20. State of Utah Economic and Demographic Projections 1992, at 330.

[136] Sizemore Memo. These data are taken from the 1987 Utah Agricultural Census, and are the most recent available.

[137] See Figure 21. Cooperative Study/Cropland, at 8.

[138] See Figure 22. Cooperative Study/Cropland, at 8.

[139] Sizemore Memo.

economic health of the region. This was not lost on the State of Utah, which noted during its Cooperative Study process[140] that

> [a]griculture in the Upper Virgin River Basin will be transformed from large fields in single crops to small "hobby farms" where a part time farmer raises small amounts of produce, mainly for personal use rather than marketing. Total cropland will continue to decrease as the large fields are divided into the "hobby farms" and sub-divisions. The demand for untreated irrigation water will decrease because of loss of cropland to sub-division and improved delivery systems, such as pressurized pipelines, for the "hobby farms."[141]

Kenneth Sizemore, Director of Community and Economic Development at FCAoG, put it even more succinctly when he noted that agriculture's days are numbered in the Washington County region, in that all presently irrigated agricultural lands are in the annexation base of the county's local communities.[142]

Agriculture is likewise of minimal dimension in the Arizona and Nevada areas of the basin. About 1400 acres are under irrigation in Arizona; the expectation is that this number will remain constant for at least the next fifty years.[143] Irrigation works in Mesquite, Bunkerville, and near the Riverside Bridge provide water for approximately 3500 acres in Nevada.[144]

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[140] The Virgin River Basin Cooperative Study was initiated by the U.S. Department of Agriculture, the U.S. Soil Conservation Service, and the Utah Division of Water Resources in order to "explore the potential for water and soil conservation [in the region,] considering development opportunities to protect and better utilize the resources in the study area." Cooperative Study, at V.

[141] Cooperative Study/Cropland, at 7.

[142] Interview with Kenneth Sizemore, FCAoG, February 25, 1993. Mr. Sizemore explained that agricultural lands in Washington County are effectively "gone," given that all such lands are included in the annexation plans of the various local governments within the county.

[143] Barrios presentation.

[144] United States Department of the Interior, Bureau of Reclamation, and Las Vegas Valley Water District. Lower Virgin River Project Plan of Study [hereinafter LVVWD Plan of Study] (1992) [at 1].

Though providing little in the way of income or employment opportunities, the agricultural sector dominates water use in the Virgin River basin. For example, estimated irrigation depletions in Washington County alone amounted to over 39,000 acre-feet, from diversions of over 87,000 acre-feet.[145] Water is used at the rate of over nine acre-feet per acre of irrigated land in parts of the Arizona Strip; the approximately 13,000 acre-feet used in 1990 accounts for more than 83% of water use in the region.[146]

Much of the reason for agriculture's high volume demand is found in the choice of crops--fodder crops, which are often flood irrigated, tend to show high evapotranspiration rates. The inefficiency of most delivery systems is also a problem. Delivery efficiencies (the ratio of water diverted to water actually delivered to an irrigated field) amongst Washington County irrigators are generally in the 70% to 90% range. More critical, however, is the *on-farm* efficiency, defined as the amount of delivered water actually put to beneficial use by irrigated crops. On-farm efficiencies for the same irrigators tend more toward 40%.[147] A company delivering, say, at 80% efficiency and applying at 40% efficiency will therefore efficiently use only about 30% of the water actually diverted.

Perhaps even more telling is a comparison between the value of products produced per unit of water in the M&I sector and that produced in the agricultural sector. Figure 25, based on data from the Utah State Water Plan and from the Bureau of Economic and Business Research, illustrates the poor economic return realized in the water-intensive agricultural sector.

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[145] See Figure 23. Utah State Water Plan, at 5-28.

Diversion and demand figures for Washington County agriculture were likewise "updated" at the July 2, 1993 Virgin River meeting. Figures contained in that update reflected (1) a 25% decline in irrigated acreage between 1990 and 2040, and (2) significant reductions in diversions and depletions for the same time period. Again, the figures offered at this time are already considered out-of-date, and will be revised with the completion of the final Utah State Water Plan.

[146] Barrios presentation.

[147] See Figure 24. Cooperative Study/Cropland, at 5.

Despite the fact that the M&I sector requires five times less water than does its counterpart, its economic contribution is some sixty times greater than that of agriculture.[148]

Irrigation demands are met primarily through surface water diversions. Several major diversions, such as those at Washington Fields and Mesquite, provide water for the few larger farms in the region. A number of lesser diversion structures shunt water from the Virgin in order to serve smaller operations. Groundwater pumping is also utilized in some parts of the basin, though it accounts for only minimal supplies.[149]

Water diverted for irrigation is applied via a variety of methods. Many operations depend on the same technologies utilized a century ago to deliver water to their crops--flood irrigation and unlined canals are still evident throughout the basin. Other farms utilize more modern drip or sprinkler systems, though the latter is often inefficient due to high rates of evaporative loss. Leaky headgates and other weaknesses in the irrigation infrastructure also can lead to water waste.

Data for irrigation uses in Washington County show that in order to irrigate just 12,820 acres, over 82,000 acre-feet must be diverted. For the basin as a whole, agriculture operations divert 123,291 acre-feet, and deplete 57,264 acre-feet.[150]

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[148] Utah State Water Plan, at 10-17 and 5-26. Bureau of Economic and Business Research. 1990 Statistical Abstract of Utah. Graduate School of Business, University of Utah: Salt Lake City (1990), at 183.

Note also that much of the use in the M&I sector consists of household demand, e.g., drinking water, etc. These demands do not necessarily yield appreciable economic benefits.

Also, the costs of the agriculture sector, in terms of water supplies, can also be quite high, given the water quality problems that often arise from agricultural operations: runoff contaminated with fertilizers, pesticides, and other chemicals; cattle-caused stream erosion; impacts to fish trapped in irrigation canals; and so on.

[149] The agricultural sector accounts for about 10% of the groundwater diverted in the Utah portion of the Basin. Utah State Water Plan, at 5-26.

[150] Utah State Water Plan, at 17-4.

The Utah State Water Plan notes that "[t]ypically, a surface irrigation system operates at less than 50% efficiency and sprinkler systems operate at about 65 percent efficiency range [*sic*]. Each 1 percent overall increase in irrigation efficiency in the basin would result in the conservation of 2000 acre-feet of water [annually]."[151] Two thousand acre-feet, it should be recalled, is the estimated daily consumption of a city the size of a future Las Vegas--about 1.8 million people.

The sheer volume of water required to prop up the basin's low-value agricultural sector is severely disproportionate to its economic importance. Perhaps even more incredible, however, is the relationship between water wasted in the agricultural sector and the mad scramble to locate water for the M&I needs of exploding urban areas.

Agriculture constitutes by far the largest depleting demand on the limited resources of the Virgin River. Taken together with depletions in the M&I sector, so-called "human" uses require a large proportion of the Virgin's flow--some 75,000 acre-feet alone are depleted in Utah, with projections calling for over 133,000 acre-feet by 2040.[152] Depletions in Arizona's stretch of the river account for another 8781 acre-feet of consumptive use, with 17,226 acre-feet anticipated by 2040. Finally, Nevada's designs on the river--seen in such proposals as the Cooperative Water Project and in the growth of Mesquite--also would result in significant depletions, perhaps as much as 70,000 acre-feet or more if the CWP is eventually implemented.

There appears to be no relief in sight, given the region's susceptibility to uncontrolled growth and its continued insistence on supporting agriculture. Perhaps the only hope for the protection of the Virgin's other values is to tackle and eliminate the traditional ways of water management now employed in the basin.

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[151] Utah State Water Plan, at 17-4.

[152] Utah State Water Plan, at 9-27.

Chapter III

The Virgin River Traditions

With each diversion, dam or reservoir proposal for the Virgin River comes a potential threat to its resources. Though each individual structure is a problem, the overriding causes of both threats and damage to the river are actually the *traditions* from which decisionmaking often emanates. These traditions tend to yield specific, on-the-ground actions that adversely impact river values.

Overall, there remains an overwhelming lack of understanding regarding the Virgin River's holistic nature and its role in supporting a diverse community of life. This lack of understanding inspires a continued focus on consumptive uses and a parallel lack of attention to instream uses. This recalls the very purpose of this report, which focuses on the need to restore balance to Virgin River management.

It's All Ours

There exists among water planning agencies in the Virgin River basin a failure to acknowledge the fact that instream users--the true "prior appropriators," as mentioned earlier--indeed possess a claim to the river's waters. An example of this failure is found in the Habitat Conservation Plan (HCP) prepared by SWCA, Inc. for Washington County:

> The importance of water development to the residents and local governments in Washington County cannot be overemphasized. Much of the water development potential exists in the aquifers beneath desert tortoise habitat on state trust lands. There is a serious concern the ability of the cities to pursue water development may be seriously curtailed should this HCP be implemented.[153]

SWCA's uncited finding asserts that the protection of water development opportunities, rather than the protection of natural resources, is the foremost goal of local governments in Washington County.

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[153] SWCA, Inc. Habitat Conservation Plan (December 1992) [at 36].

Concern regarding water development's impacts on native fish, on the other hand, is apparently absent within these entities. In fact, the emphasis on protecting water development opportunities seems to result in the donning of blinders in many cases. The HCP also reports that "[o]nly the desert tortoise occupies habitat in areas slated for growth in the County"[154]--a completely false and ridiculous statement. While it is true that no one is likely to build a house or factory in the Virgin's stream channel, it is no less obvious that growth in Washington County--or at least the impacts of that growth--will affect native fish habitat. This probability is all but ignored in the HCP, however, an omission that portends continued showdowns over federally mandated protection for rare species.[155]

The "It's All Ours" tradition is also illustrated in attempts by local and state water planners to subvert federal claims to Virgin River water. WCWCD General Manager Ron Thompson, in response to the BLM's decision to claim instream flow rights in the Arizona Strip, suggested that the instream flow application appeared to be

> an attempt by the BLM to usurp water rights...We are very concerned about it and do not believe BLM has a factual or legal basis in which to sustain a claim.[156]

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[154] Habitat Conservation Plan, at 1.

[155] Note also that the Habitat Conservation Plan contemplates "no take" for woundfin, Virgin River chub, bald eagle, and other special status species. By doing so, the HCP simply fails to recognize the link between urban growth and the loss of habitat and populations for various T&E species, particularly fish species.

The likelihood of impacts to woundfin and Virgin River chub are addressed in a single paragraph in the HCP: "It is anticipated there will be no adverse impacts to the population of woundfin and Virgin River chub in Washington County, thus producing no additional threats to the survival of these species. The habitat of these fishes will not be impacted by the HCP. Several development areas exist near or adjacent to these rivers, but development activities are not expected to have a negative impact on waterborne insects, the primary food base of these fishes." Habitat Conservation Plan, at 61. In short, the HCP evinces a genuine lack of knowledge regarding river management as it pertains to native species protection, to the adverse impacts of changes in natural flow regimes, to changes to riparian areas, and to changes to water quality.

[156] Webb, Loren. "BLM Proposes Stable Levels of River Water." The Daily Spectrum (January 27, 1993).

Also expressing an opinion on BLM's filing was Larry Anderson, Director of the Utah Division of Water Resources:

> We don't want these filings to limit what Utah can do in the future in developing its water supply.[157]

Yet another form of the "It's All Ours" tradition is seen in the failure of local water agencies to acknowledge the interstate nature of the river. As the Virgin is a "tri-state" river, its flows cannot be claimed by any one state. Oddly enough, however, it is not unusual to discover evidence that the three basin states have yet to accept this notion.[158] There is, at least in terms of management planning, an obvious lack of attention to interstate issues. Though the states have signed a Memorandum of Understanding regarding research and information sharing, there exist few vehicles to ensure that the Virgin is managed as a single river, rather than as three individual segments of a river.[159]

In fact, there is at times a keen sense of competition evident in the day-to-day workings of the three basin states. During a January 1993 public meeting, Washington County Commissioner Russell Gallian expressed concern that OPB's population projections, criticized as too low by the commissioners, could cause problems for the county: "I'm afraid these exhibits [presented by the state] will be used by Las Vegas" in an attempt to gain more

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[157] Webb (January 27, 1993).

[158] While working to secure maps of the Virgin River for purposes of this project, I was struck by the fact that each entity willing to provide information had access to maps of individual segments only. For example, after requesting that UDWR send me a map of the Virgin, I received a document showing the river from Zion National Park to the Utah/Arizona border. Someone unfamiliar with the river could have concluded, based on that map, that the river indeed came to a halt before entering Arizona. The same phenomenon was observed among water management agencies in Arizona and Nevada.

[159] Arizona Department of Water Resources, Nevada Division of Water Resources, and Utah Division of Water Resources. Memorandum of Understanding Regarding the Virgin River (May 1992). Other cooperative efforts include the Fish and Wildlife Service's Native Fish Recovery Team and BLM's instream flow study team.

water from the Virgin River.[160] Likewise, WCWCD's Thompson has explained that the upcoming Washington County buildout study is "necessitated because of increased water needs [in] nearby Las Vegas...."[161]

Bigger Is Better

Interviews with, and documents provided by, water planning officials in Utah, Arizona, and Nevada form an important component of this report. A review of those documents and the notes from dozens of hours of interviews unearths a sentiment common to almost all of them: unfettered municipal growth is regarded as a given, if not a desirable outcome--even in the face of difficult water supply questions. Because of the "Bigger is Better" tradition, the most fundamental question--How much urban growth is sustainable, and how much is "good"?--may go unasked. Instead, the question becomes one of "How much growth is possible?" Economist R. Thayn Robson, the Executive Director of the University of Utah's Bureau of Economic and Business Research, recently stated that he envisioned Washington County's population approaching 130,000 by the year 2020. Robson went on to say that

> I don't see any real barrier to those continuing growth rates...Are there real barriers to growth in Washington County? In my view there are not.[162]

It seems clear that Mr. Robson does not understand that water availability--in the sense of what water is available to all reasonable uses--will ultimately determine growth limits, and that availability assuredly will reflect in part the demands of instream users. There is simply no way that the basin contains enough water to meet the concurrent needs of "unlimited growth" and the needs of other river resources.

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[160] Webb, Loren. "What is the Population of Washington County?" The Daily Spectrum (January 30, 1993).

[161] Webb, Loren. "Agencies Ready To Draft County Population Plan." The Daily Spectrum (n/d).

[162] Lindquist-Applegate, Julie. "Economist: There are no barriers to area growth." The Daily Spectrum (April 2, 1993).

The same tradition is in place in Las Vegas, Mesquite, and Cedar City--all are undergoing unprecedented growth, and all are operating under the delusion that the already-overextended waters of the Virgin River can meet the thirst that comes with it.

Have Cake, Will Eat

Despite clear evidence regarding the declining economic importance of the agricultural sector--and of problems regarding the demand for and use of water in the sector--water planners often exhibit a desire to preserve farming activity at its current levels. The Utah State Water Plan in several instances voices its intent to retain the *status quo*. Beginning with the false assumption that "agriculture continues to be a very important part of the [Virgin River basin] economy,"[163] the Plan goes on to argue in favor of a management approach that would "maintain presently irrigated land by recommending future urban development in nonirrigated areas."[164]

Strangely enough, the institutional response to the market-based demise of agriculture has actually been a call for more structural development. Utah suggests that "[i]rrigation companies [in the Virgin River basin] need to pursue development of more water storage facilities as part of multipurpose projects to provide a more stable supply [of water] for late season use."[165] In other words, the Division of Water Resources proposes that the proper course of action to follow, given the lessening importance of agriculture in the basin, is one that would demand the construction of even more dams, diversions, and reservoirs. In fact, the misallocation of water to the agricultural sector may be the greatest limit to urban growth, as well as to the provision of water for instream demands.

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[163] Utah State Water Plan, at 10-1.

[164] Utah State Water Plan, at 7-6. The plan also suggests that federal and state lands could be purchased or traded for in order to meet needs for residential and commercial land.

[165] Utah State Water Plan, at 10-3.

The Insatiable Thirst

The habit of providing structural-based responses to increasing water demands often manifests itself in a peculiar set of institutional behaviors amongst water planners. Perhaps the most destructive of these habits arises from the perception, often shared by water development interests, that a particular waterway is "up for grabs" and thus available to the first entity that claims it. This may be viewed as a throwback to the tradition of prior appropriation, yet it more likely results from a lack of inter-disciplinary management on the river.

As the Virgin River is both without a compact and is, at this time, managed by a variety of historically non-coordinated local, state, and federal agencies, its waters are especially vulnerable to entities that would work toward monopolizing the river's resources, ostensibly in order to service the demands of the most optimistic population projections. For example, the WCWCD holds pending applications for some 119,000 acre-feet of water in the Virgin River basin.[166] State of Utah projections, however, show Washington County's M&I demand barely above 90,000 acre-feet by the year 2040,[167] while WCWCD's own projections show the county demanding less than 50,000 acre-feet by 2010.[168]

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[166] Of course, the mere completion of a water right application does not mean that WCWCD actually possesses a right to that volume of water. Under the prior appropriation doctrine generally, the entity filing for a right must, with some diligence, prove application of the water to a beneficial use. More specifically, Utah law requires that the appropriation of water "must be for some useful and beneficial purpose...." U.C.A. §73-3-1.

Only after the State Engineer is satisfied that the beneficial use requirement has been met will the right be perfected and a certificate of application issued. U.C.A. §73-3-17. In WCWCD's case, its applications will be certificated only after the appropriate dam/diversion proposals have been implemented.

[167] Utah State Water Plan, at 11-7.

[168] Another example of the imbalance between perceived demand and actual demand in Washington County is found in the current status of the Quail Creek reservoir. According to WCWCD, about 6000 acre-feet of the reservoir remains unallocated. At the same time, St. George--even though it has grown at phenomenal rates over the last decade and a half--is using only about 50% of its allocation of 10,000 acre-feet of Quail

(continued...)

While some would view WCWCD's applications as responsible planning, they can also be seen as part of a larger attempt to monopolize the Virgin's water supply and thus prevent claims and development by "competing" entities and/or to limit the amount of water guaranteed to instream uses. Additionally, numerous groundwater applications filed by private entities point to the possibility of speculation in the Virgin's water resources.

Though urban growth is exceeding six percent annually in some basin cities, water planners in the region have so far failed to develop or implement substantive proposals to limit M&I or agricultural water demand. Water conservation plans that are advanced generally fail to provide the incentives necessary to reduce consumption. For example, the "new" conservation plan approved recently by the LVVWD Board is in truth only a reissue of its old "Level I" conservation plan proposed in 1989. Though enunciating the objective of reducing M&I use by 17%, the plan is silent on retrofitting and other necessary conservation means. Small water rate increases, also intended as an incentive to limit use, are in fact offset by reductions in monthly service charges, allowing Las Vegas' water rates to remain among the cheapest in the West."[169] Likewise, the Utah State Water Plan, though apparently subscribing to the goal of water conservation in the M&I sector, actually bases its projections for future water demand in the basin on current use levels.[170] Despite this lip-

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[168](...continued)
Creek water. Overall, there exists a surplus of somewhere between 10,000 and 15,000 acre-feet in Quail Creek reservoir alone. Coordinating Council for Washington County Water Issues meeting, July 1, 1993, St. George, Utah.

[169] Benezet, Louis. "Las Vegas Water Grab Hearings Delayed Indefinitely...And Water District Lags Behind In Reports." Citizen Alert (Fall 1992) [at 12].

[170] Section 17 of the Utah State Water Plan addresses water conservation issues. Using figures presented in Tables 11-3 and 4-1, a quick calculation shows that UDWR intends to divert .452 acre-feet per person in St. George in order to supply M&I water in the year 2020. This is the same amount diverted currently, according to those tables. The "update" provided by the Division of Water Resources at the July 2, 1993 meeting of Virgin River interests included a goal of reducing consumption by 25% over the span of 45 years, beginning with undescribed programs that would work to reduce demand by one percent a year for the first fifteen years of their implementation. The Division of Water Resource's final declarations on conservation will not be known until the Utah
(continued...)

service to conservation, then, UDWR continues to plan for a future free of limits on per capita water consumption.

While failing to devise rational conservation plans, water planners have found time to propose any number of outlandish schemes to bring even more water to the basin. UDWR's decision to even consider seven damsites within Zion National Park, or another nine in the Pine Valley Wilderness for that matter, pales in comparison to other scenarios reviewed. Planners in Nevada, for example, have outlined a project to move some 300M acre-feet of water from southeast Alaska annually. The imported water, which would be brought to the West Coast in "large synthetic bags," would then be traded for California's shares of Colorado River water.[171] While serious water planning efforts remain rare, ridiculous "solutions" that do nothing to fend off the inevitable need to control demand appear to be in surplus.

It's Cheap, So Use It

Additional proof that water planners choose to focus more on securing additional water supply than on addressing potential changes to water demand is also reflected in water pricing structures. A review of the rate schedules for three major water providers in the Virgin River basin--Mesquite Farmstead Water Association, St. George city, and LVVWD--shows that pricing incentives that could work to limit wasteful consumption go unused in all three. In Mesquite, for example, the rate per thousand gallons is identical for all users, no matter what their monthly demand may be. That is, a household connected to a 3/4" meter would pay $1.20 per thousand gallons for the first 50,000 gallons consumed, and $1.50 per

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[170](...continued)
State Water Plan is released in its final form.

Likewise, use projections for the town of Littlefield supposedly include the implementation of water conservation measures--yet ADWR projections for the year 2040 assume M&I consumption will be at 300 GPCD, a 20 increase from the current 250 GPCD.

[171] "Nevada's solution could be in the bag." The Daily Spectrum (January 1, 1993).

thousand gallons for every thousand consumed after that. An industrial user connected to a 10" pipe, on the other hand, would pay the same $1.20 per thousand--except that this rate would apply to the first 3.3 million gallons consumed. Further, consumption beyond the 3.3 million gallon threshold would be billed at the household rate of $1.50 per thousand.[172] The same general approach is utilized by both St. George[173] and LVVWD.[174]

Such regressive rate structures invite users to all but ignore their consumption habits. As long as price increments are few and the difference between increments small, users have no incentive to limit their water consumption, or to be concerned about the waste of literally thousands of gallons of water. To use an example from the Mesquite schedule, a consumer using 200,000 gallons monthly via a 2" connection would be charged $240.00 (the $130.00 minimum charge would pay for the first 108,333 gallons, with the remaining 91,667 gallons costing $110.00). An identical industry using 220,000 gallons--and, in effect, wasting 20,000 gallons per month--would pay only $30.00 more monthly (20,000 additional gallons at $1.50

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[172] Mesquite Farmstead Water Association. Monthly Water Rates and Service Charges (September 1, 1992). Minimum costs for monthly service are significantly higher for high-volume users ($14.50 for a 3/4" hookup versus $1935 for a 10" connection); however, the setting of a minimum baseline does not provide any incentive for reducing demand. In fact, it may actually provide some incentive for wasting water, as users may be tempted to boost their usage in order to "get their money's worth" out of the minimum charge.

[173] St. George employs ten increment levels for M&I users, and raises the price per thousand gallons five cents for each additional five thousand gallons used each month. The first five thousand gallons of M&I use are included in the base charge.

Irrigators pay a flat $15.00 monthly charge for the first 5000 gallons. There are five increments above the base level, with those using more than 5 million gallons paying eighty cents per one thousand gallons used. City of St. George. Water Rate Schedule (n/d).

[174] LVVWD customers pay an increasing service charge based on volume used. Consumption is then billed at ninety-eight cents per one thousand gallons for use below a certain threshold, and $1.16 per thousand above that threshold. Las Vegas Valley Water District. Water Rates and Billing Information (n/d).

per thousand). Such a minimal increment is unlikely to serve as an incentive for the second industry to bring its consumption in line with the first.[175]

Effects Have No Cause

> *There are those here and throughout the county who will point their fingers and aver, "I told you so!" Let us not listen to them. It is Dixie tradition that we learn from our mistakes, and start over again.*[176]

All communities making the transition from largely rural to urban are initially surprised at the changes, many of them adverse, accompanying that growth. Perceptions of a decline in quality of life are not unusual, nor are general concerns that the community is evolving into a place very much unlike what it once was.

St. George is currently undergoing such growing pains. In addition to a rapidly expanding population, St. George is also seeing a marked increase in crime--1991 showed a 19.4% hike in the crime rate from 1990, and 1992's rate jumped another 9.6% above that.[177] Increased traffic congestion, which tends to plague all growing communities, is also a problem in St. George. Twelve years ago, when St. George's population numbered

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[175] It seems that the effect of the structure would be more pronounced as consumption increases. Some quick math shows that someone using 3.63 million gallons (e.g., 10% over the first increment) would pay only $495 more for water than someone using 3.3 million gallons.

It should not be assumed that water is wasted only in the industrial portion of the M&I sector. A newspaper account of recent problems with soil slippage in Santa Clara, Utah noted that "there are strong indications that [that problem is caused by] excessive lawn watering--an average of 100 inches of rainfall annually per home and, consequently, excessive water runoff throughout the entire region. Water is a major problem here." Lyle (January 4, 1993) [emphasis added]. A researcher reviewing the problem for Santa Clara has recommended that the city advise homeowners to reduce lawn watering by 90 percent.

[176] Glasson, Mattie. "Quail Creek Dike Has Been Leaking for a Long Time." The Daily Spectrum (January 8, 1989).

[177] Summerill, Scott. "Big Jump in Youth Crime." The Daily Spectrum (January 24, 1993).

about 12,000, traffic on St. George Boulevard peaked at a little over 17,000 cars daily. Current daily traffic on the boulevard is 25,000 vehicles. Bluff Street, another main thoroughfare, saw traffic climb from 5,180 to 25,375 vehicles per day in the same 12 years.[178] Kenneth Sizemore of FCAoG noted also that shrinking access to efficient transportation will perhaps be the major growth-limiting factor in southwest Utah, as plans to construct high-volume beltline routes around St. George would likely be impeded by requirements for endangered species protection and other obtacles.[179]

A causal relationship between these changes and the onset of growth in St. George is difficult to establish with any certainty. Some are willing to try to establish such a link, however. Deputy Chief Kelly Larson of the St. George Police Department said that "most of the [crime] increases can be directly related to population growth in the city," and also noted

> People are moving here from inner city areas to get their kids away from crime. But many of the kids are already into that lifestyle and they just bring it with them.[180]

Studies regarding the adverse impacts of out-of-control growth tend to agree on one fundamental notion: growth tends to bring with it a range of social problems, including increased air and water pollution, loss of open space, increases in crime and accidental deaths, increased tax burdens and housing costs, and so on.[181] Increased government spending may be able to address some of these concerns; however, local governments are often more focused on simply coping with major infrastructure needs, such as roads and schools, and thus cannot address other growth ramifications. The result is that the costs--

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[178] "Improving Street Safety" (editorial). The Daily Spectrum (January 24, 1993).

[179] Sizemore interview.

[180] Summerill (January 24, 1993). This article also reports the growing rate of domestic violence in St. George, and quotes Kelly as to why domestic violence has increased in St. George: "What happens is people move into the area and can't find jobs that pay enough to support the family."

[181] See Sierra Club Rincon Group. Saguaro We Going? Tucson, Arizona (1988). Also see Sierra Club San Gorgonio Chapter. Environmental Impacts of Population Growth in California's Inland Empire (1989).

fiscal and otherwise--are spread among the general population, while the benefits tend to be shared by a relatively small club of developers and business interests.

Despite the impacts of growth already felt in St. George, Las Vegas and other communities in the basin, decisionmakers continue to plan for populations far in excess of present numbers. This occurs in the face of significant problems already witnessed at population levels far below what is called for in projections. Even those impacts that can be confidently attributed to growth, such as increased traffic congestion, have apparently not been serious enough to induce planners to revisit the need for growth controls.

There is thus little hope that communities will "learn from their mistakes" when it comes to understanding the links between growth, water demand, and water resource availability. As seen above, the pattern has been to answer increased water demand with traditional and largely failed structural approaches. One of the suggestions forwarded by WCWCD during its budget planning meeting in December 1992 was the familiar refrain that the "district continue to acquire lands and [set them] aside for potential reservoir sites...."[182]

While prospects for replacing the "effects have no cause" tradition may appear bleak, there is reason to hope for change in some sectors of the basin. A recent St. George Daily Spectrum editorial noted that

> While there are numerous advantages to growth, there are an equal number of disadvantages to unchecked growth...Hopefully, what we've learned from other growth areas is that unchecked growth is always followed by pollution, overpopulation and heedless exploitation of natural resources.[183]

Each of the previously-described traditions lead to an assured outcome: a single-minded focus on structural approaches to meeting water demand, as reflected in the poor quality of water planning at local and state levels, in the constant tendering of dam proposals

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[182] Webb, Loren. "Water agency approves $11.9 million budget." The Daily Spectrum (December 17, 1992). This proposal has since been realized in WCWCD's attempts to purchase state land parcels in both the North Creek and North Fork regions of the basin.

[183] "Protecting Our Natural Assets" (editorial). The Daily Spectrum (December 18, 1992).

in ecologically critical areas, in policy aimed at protecting consumptive uses at all costs, and in the indifference toward the needs of other river-dependent resources. What results from the Virgin River traditions are specific threats to the Virgin river like those outlined in the following chapter.

Chapter IV

Threats To The Virgin River

For scale of engineering, for wealth produced, the American West had become by the 1980s the greatest hydraulic society ever built in history. It had far eclipsed not only its modern rivals but also its ancient ones, Mesopotamia, Egypt, Mohenjo-Daro, China, and the rest. It had made rivers run uphill, made them push themselves up by their own energy, and celebrated the achievement in brilliant neon colors playing over casinos, corporate offices, shopping malls, over all its new-age oases. It had turned an austere wilderness into sparkling serpentine seas where fleets of motorized houseboats circled under hot cloudless skies, where water skiers turned playfully in and out of once desolate, forbidding chasms. Then it had taken that same water and raised cotton with it, filled city pools with it, thrown it into the air with fountains and let it blow away. It had made its rivers over to produce art, learning, medicine, war, vulgarity, laughter, stinginess, and generosity. All this it had done with unmatched zeal, and most of it with the aid of the East.

--Donald Worster, Rivers of Empire

Of all the obsessions and fixations of the West, perhaps none is taken as seriously as water development. With the exception of a few remaining free-flowing watercourses, western water is subject to an enormous maze of dams, diversions, reservoirs, pumps, canals, pipelines, storage tanks, treatment plants, and wells. Efforts to tame and make green the arid lands of the region have produced a waterworks system serviced by an untold number of federal, state, and local agencies, public and private water corporations, and individual water rights holders. The developers of Western water look to these structures as shining examples of human ingenuity and commitment, as engines of economic growth. Others see them as needlessly complicated, incredibly inefficient and expensive, and often as sources of corruption.

As described above, water is also important for those resources without access to the infrastructure. A huge and diverse wildlife population, including an array of rare species, depends on ever-diminishing riparian habitat for both food and shelter. The success of recreation and tourism industries--a rapidly expanding sector of many local economies--is also related in no small part to the availability of free-flowing water.

Simply stated, there is not enough water in this fragile basin to go around. The historical focus has been on directing water supplies to industrial and agricultural uses, while leaving what remains, or in some cases what is prohibitively expensive to develop, to wildlife and other instream uses. This unbalanced approach in turn depends upon the

construction of dams and other structures to meet expanding water needs, and generally ignores longer-term solutions such as water conservation and the development of appropriate economies.

The Impacts Of Dams Generally

> *Without doubt the damming of rivers has been one of the most dramatic and widespread, deliberate impacts of man on the natural environment. Yet, paradoxically, the nature of the impact--the range and magnitude of the induced environmental changes--has become widely appreciated only during recent years. We may not, even now, be aware of the full extent of the biotic species extinctions and other changes that can result, directly or indirectly, from river impoundment.*[184]

Structural solutions to water management in the Virgin River bring with them a host of inherent problems. There are of course the general impacts of construction itself--noise pollution, fugitive dust emission, erosion from vegetation loss, and so on. Concerns also focus on the highly-gypsiferous soils in the Washington County region of the Virgin basin and their suitability for dam-building projects. An unpublished report of the Utah Geological Survey notes that

> [g]ypsiferous deposits are subject to settlement caused by dissolution of gypsum, creating a loss of internal structure and volume within the deposit...Gypsiferous rock and soil deposits have the potential to cause damage to foundations and to cause land subsidence and sinkholes similar to those seen in limestone terrains. Gypsum is also a weak material with low bearing strength. When gypsum weathers it forms sulfuric acid and sulphate [citation omitted]. These compounds may react with certain types of cement, weakening foundations by damaging the exterior surface. When wetted by irrigation for crops or landscaping, or by water from wastewater disposal systems, gypsiferous soils may subside due to dissolution of gypsum. In some cases large underground solution cavities may form and then collapse.

The Quail Creek disaster of 1989 was caused in no small part by the dambuilders' failure to account for the inadequacies of gypsum-based soils in and around the damsite. A number of

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[184] Petts, at xiii.

other researchers have determined that the region's soils commonly contain large amounts of gypsum, and are otherwise characterized by a prevalence of rapidly eroding components.[185]

Dams tend to severely damage wildlife habitat, both upstream and downstream of the actual site. Flood pools formed on the reservoir side of a dam can destroy hundreds of acres of high-quality habitat, including precious riparian areas and terrestrial habitats. Impacts related to changes in a river's flow regime can also be serious, as most native fish species have evolved within certain flow patterns, water temperature variances, and other river characteristics. Changes in these factors--such as the loss of flash flood events that flush debris, deposit nutrients, and control exotic populations--in turn often threaten the continued survival of native species by removing an important component of habitat sustainability. This is certainly the case on the Virgin, where the river's often wild streamflow fluctuations are critical in sustaining native fish habitat:

> Variability in streamflow is a dominant feature of the physical environment of the Virgin River...This extreme physical variability maintains relatively uniform habitat characteristics and tends to restrict the fish fauna to those few generalized species capable of surviving the variable physical conditions of the Virgin River.[186]

Because of these unavoidable impacts, dams present a particularly large obstacle to wildlife protection. As one observer notes, "If the Virgin River is controlled and developed more than at present, we may anticipate increasingly difficult problems in maintaining viable native fish populations...It is essential to recognize that each reservoir completed and each water

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[185] See, e.g., Hydrologic Inventory, at 13. While no damsites have been proposed directly atop faults, several have been proposed for construction near faults, particularly the Hurricane and Sevier faults. See generally Utah Department of Natural Resources, Division of Water Resources. Preliminary Analysis of Potential Damsites in the Virgin River Basin [hereinafter Preliminary Damsite Analysis] (1992).

[186] Deacon, James E., and Thomas B. Hardy. "Streamflow Requirements of Woundfin: Cyprinidae in the Virgin River, Utah, Arizona, Nevada." In Horner, N.V. (ed.). Festschrift for Walter W. Dalquest in Honor of His Sixty-Sixth Birthday. Midwestern State University (1984) [at 53].

diversion will likely adversely influence the native fishes of both the affected tributary and the mainstem...."[187]

A myriad of other resources--ranging from archeological sites to riparian values to wild and scenic river potential--also stand to suffer every time a dam is constructed. The Quail Creek project is but one example where a structural response led to the deterioration of such values as habitat and natural streamflow variances. Further, the sheer economic costs of dams and reservoirs are generally substantial, and may in fact limit a water entity's ability to shift water management strategies if, for one reason or another, future structural approaches are foreclosed.[188]

In addition to the threats common to all damsites, each dam proposal throughout the Virgin River basin presents its own unique set of site-specific concerns. This is particularly evident in Utah, where the majority of damsite proposals for the basin have been advanced. A UDWR study completed in 1992 evaluated over ninety potential damsites.[189] Of the

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[187] Deacon (1988), at 23.

[188] At a recent meeting of the Utah State Board of Water Resources, one Board member stated that water conservation approaches could not work in Washington County because reduced demand--and thus, reduced customer bills--would in turn remove a source of income to WCWCD and thus limit its ability to pay off existing dams and reservoirs.

Cost is often not an object in structural planning, at least according to the Utah Division of Water Resources. In its Advisory Review Draft plan for the Virgin River basin, the Division failed to acknowledge the costs of environmental impacts and of mitigation, though it did develop figures for overall project costs and costs per acre foot of storage. Utah Department of Natural Resources, Division of Water Resources. Utah State Water Plan: Lower Colorado River Basin [hereinafter Advisory Review Draft] (1992) [at 9-25]. Public comments regarding the Advisory Review Draft pointed out that mitigation and environmental costs should be referenced in the table in order to best understand the actual costs of structural approaches to water management.

Rather than address those issues in the subsequent draft, however, the Division simply excised the two cost-related columns from the previous table. Utah State Water Plan, at 9-24. Perhaps the Division did not wish to fully analyze the full range of potential costs; or, on the other hand, it may be sending a signal that economic costs (including environmental impact costs) are not a significant issue in water management planning.

[189] Preliminary Damsite Analysis, at 5.

original 98 sites chosen for study, 35 were eliminated due to their location within national parks or wilderness areas, or near existing reservoir sites; sites whose flood pools would directly impact local populations were also deleted.[190] A second review, completed in 1988, dropped all sites where reservoirs would be limited to less than 3000 acre-feet of storage, leaving a total of 36 sites under review. A third round of study analyzed the remaining sites, and eventually dropped eighteen for failure to meet certain criteria regarding geology, location, topography, and construction material availability.[191] The Utah Division of Water Resources currently regards sixteen sites as under study in the Utah portion of the basin.[192]

Proposals to develop damsites--both at these remaining sites and in other locations--have surfaced, disappeared, and often resurfaced over the years. Proposals have also been floated to construct transbasin projects to provide Las Vegas and Cedar City with Virgin River water. With the exception of Kolob Reservoir, however, not one of these projects has seen ground broken; nevertheless, the proposals outlined below are components of the threatening atmosphere that rests over the Virgin River and its dependent resources. The damsites discussed below are also keyed to Map 1 in the Appendix.

North Creek (Site #5)

The Washington County Water Conservancy District, since 1987, had focused much of its ample energies toward construction of a dam and reservoir on the North Creek, on a site just upstream from the town of Virgin, Utah. The proposed dam measured 130 feet high, about 3800 feet long, and formed a storage pool of about 20,000 acre-feet.

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[190] Preliminary Damsite Analysis, at 2.

[191] Preliminary Damsite Analysis, at 13.

A December 9, 1992 letter from WCWCD to BLM's Dixie Resource Area refers to 20 potential sites with the Resource Area, and requests that BLM planning efforts address all potential sites.

[192] See Figure 26. Utah State Water Plan, at 9-24.

Of particular concern was the fact that the proposed reservoir would inundate over 500 acres of the Virgin oilfield, which was abandoned in 1986. As records regarding oil drilling activity in the Virgin field are incomplete, there is no certainty about the number of abandoned wells in the area, about the number of wells that have been successfully capped, or about the status of those wells still uncapped.[193] Estimates of the number of wells drilled in the field range from about 140[194] to a yet-undetermined number in excess of 250[195]. In addition, field reviews show that numerous sites contain physical evidence of oil-related activity, including oil spills, storage tanks and tank sites, telephone and electrical poles, pumping equipment, buildings, junk vehicles, and other equipment.

Because of these and other information gaps, the BLM expressed concern that water stored in the North Creek reservoir could be contaminated by outflow from any undiscovered and/or uncapped well. In a September, 1992 letter to WCWCD, BLM cited a July, 1992 report, prepared for WCWCD by Dames & Moore, Inc., which states that "[t]he risk that oil will be present in the proposed North Creek reservoir is very high...The risk is greater than 50 percent that oil will still seep into the reservoir even after plugging the oil wells that have

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[193] Engineering reports prepared by WCWCD-hired contractors reflect the inadequacy of recordkeeping at the Virgin oilfield: "It is possible that not all wells that have been drilled in the Virgin Oil Field are recorded. Also, the number of wells located is based upon the information from Alpha Engineering. Not all of the sites that Alpha located are wells. Therefore the number of wells that must yet be found will in all probability exceed the total of 76...." Dames & Moore, Inc. North Creek Oil Well Remediation Plan for Washington County Water Conservancy District [hereinafter Dames & Moore II] (November 13, 1992) [at 5].

Further, poor wellsite recordkeeping began, apparently, with the very first well drilled in the Virgin oilfield. One observer notes "The first [oil] well is about two miles northeast of Virgin City, in Section thirteen, Township forty one, South Range twelve...in the flood plains of North Creek...A complete record of the well was not kept." Snow, Leo A. Salient Geological Features of the Virgin City Oil District (B.S. thesis). University of Utah: Salt Lake City (1908) [at 11].

[194] Dames & Moore, Inc. Evaluation of Oil Wells/North Creek Reservoir Near Virgin, Utah [hereinafter Dames & Moore I] (July 30, 1992) [at 3].

[195] Driscoll, Patrick L. "Virgin Oil Field." In Four Corners Geological Society. Oil and Gas Fields of the Four Corners Area (1978) [at 712].

been located."[196] The D&M report goes on to suggest that "[a]lternative dam and reservoir sites should be considered because of the uncertainty of finding all of the sources of oil within the proposed reservoir area. One well or seep not found may contribute unacceptable amounts of hydrocarbon to the stored water in the North Creek reservoir."[197]

Just two months after BLM's letter, however, D&M (still under contract with WCWCD) backpedaled from its original position. The firm's second report, issued in November, 1992, outlined a remediation plan it claims could be implemented on the Virgin oilfield.[198] This second report was a significant departure from the first, especially in its assertion that "...it will be possible to find and plug the oil wells within the North Creek

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[196] Letter from Debbie Pietrzak, Resource Area Manager, Dixie Resource Area, to Ron Thompson, General Manager, WCWCD, citing Dames and Moore I, at 11.

[197] Dames and Moore I, at 12. Note also that another WCWCD contractor reports that "Most of these wells [in the Virgin oilfield] were drilled in the early part of the century, before any regulations were established by the State of Utah in regard to procedures to be followed when plugging and abandoning depleted wells. Consequently, many of the early wells may never have been plugged and were certainly never properly marked or identified. It is probable that many of these wells still communicate from the surface to the oil reservoir and will allow water from the lake to penetrate into the oil reservoir if they are not properly plugged." Hebertson, Keith M. Water Invasion Possibility: North Creek Dam (January 1993) [at 1].

[198] Cost estimates for the remediation plan range from about $600,000 to $5.8 million. The lower-end cost estimate assumes that only 76 wells will need to be located, that only 71 wells will require capping, and that 42 will require only plugging and capping. The minimum figure also rests on the assumption that soil disposal and equipment cleanup can be accomplished for under $160,000. Dames and Moore II, at 11.

Much higher costs would be involved if a "blanket" is required to cover the oilfield area impacted by the reservoir. However, researchers at the Army Corps of Engineers Office in Oklahoma suggest that this approach probably will not be a "permanent" solution, as the blanket would become an obstacle to mitigation if a leak should be detected (i.e., the blanket would have to be excavated to find even the smallest leak that may appear after the blanket is in place). Interview with Donald Warnken, United States Army Corps of Engineers (ACOE), March 8, 1993. Keith Hebertson echoes Warnken: "Until such time as invasion of oil into the lake is observed, it is not recommended to install the blanket monitoring system over all possible sites, as described in the Dames & Moore report of November 13, 1992." Hebertson, at 3.

reservoir area."[199] D&M also contradicted its original findings by deleting its initial suggestion that North Creek, because of water quality concerns, is a risky site for a dam and reservoir.[200] The new report, while not disputing the earlier finding that at least 75 wells believed to lie in the reservoir area remain undetected, concluded that "[w]ith the completion of this remediation plan it is considered that the potential for oil seeping to the ground surface is very low."[201]

The BLM, which would have been the lead agency in the event that an Environmental Impact Statement was prepared for the project, immediately signaled its desire for a go-slow approach. In its September 1992 letter to WCWCD, the agency stated that "...our review of the [first] Dames & Moore report leads us to question whether the impacts of the oil field can be mitigated sufficiently....Please be advised that pending resolution of the oil field issues, the BLM will take no further action toward selection of an EIS contractor and completion of an EIS analyzing the North Creek reservoir proposal."[202]

A subsequent report from the BLM's State Office in Salt Lake City seemed to dispute D&M's optimistic conclusions, noting that "emission of petroleum does occur unless a

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[199] Dames and Moore II, at 10.

[200] Morgan Jensen, Environmental Coordinator at WCWCD (and former Manager of BLM's Cedar City District), noted at a February 18, 1993 meeting of the Cedar City District Advisory Council that, far from being a risk, the proposed North Creek Reservoir could in fact be viewed as a multiple-use bonanza. Jensen's notion was that the hydrostatic pressure exerted by the water in the reservoir could force oil out of the ground through natural seeps in the Virgin River Gorge. Then, according to Jensen, the oil could be collected and sold, bringing additional revenue from the project. However, this particular approach was never part of WCWCD's application process.

[201] Dames and Moore II, at 10.

Hebertson's report adds "It is the opinion of the writer that any water invading the oil reservoir through abandoned wells will push any residual oil away from the well bores toward the area of least pressure, which is the surface location of the Timpoweap outrcrop...It is therefore only a remote possibility that there will be any significant amounts of oil introduced into the lake before, and if, the seep becomes active." Hebertson, at 2.

[202] Letter from Pietrzak to Thompson, at 2.

perfect abandonment of all existing wells is accomplished."[203] That same report also found that "[t]o allow the reservoir of oil to be reenergized by the water in the proposed reservoir, [then] to allow the dirty oily water to flow in the oil seep area will be an environmental disaster of large proportion considering that the water will end up ultimately in the Virgin River and the Colorado River."[204]

Just prior to the final publication of this report, BLM informed WCWCD that it would not approve the District's application for a right-of-way, effectively killing the North Creek proposal. Calling the proximity of the oilfield a "fatal flaw," BLM cited the concerns of several experts regarding the probability of petroleum contamination in the reservoir, as well as BLM's likely liability if contamination did occur. The agency did not rule out the possibility that WCWCD could reapply; however, the District was put on notice that any subsequent proposal in the North Creek region would have to be accompanied by a Plan of Development outlining a scheme to prevent water quality problems.

Ash Creek Reservoir/Sand Hollow Reservoir/Pah Tempe (Site #3)

Soon after BLM announced its decision to deny WCWCD's North Creek right-of-way application, the Conservancy District unveiled yet another structural proposal for the Virgin River basin. The plan, which was presented at a June 15, 1993 meeting of public agencies and environmental organizations, proposes development in as many as three separate sites, though it is unclear if each project is considered a separate entity, or if WCWCD considers them as interrelated parts of a single system. Two new reservoirs are envisioned: one in the Sand Hollow area southeast of Quail Creek Reservoir, and another, called the South Ash Creek Reservoir, which would be located just west of the existing Ash Creek Reservoir, near the town of Anderson Junction. The third phase WCWCD described called for water from the highly saline Pah Tempe Springs to be diverted so that it enters the Virgin River near the Washington Fields diversion, far downstream from where it now flows into the waterway.

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[203] File memo from A.M. "Jimmy" Raffoul, Petroleum Engineer, BLM Utah State Office.

[204] Raffoul file memo, at 3.

The WCWCD has also filed water rights applications in the same areas, including one for 10,000 acre-feet annually from South Ash Creek, 10,000 acre-feet from Leap Creek, and 6000 acre-feet from Wet Sandy Creek[205]: all of these would feed the proposed South Ash Creek Reservoir. The Conservancy District has also forwarded applications for groundwater in the region.[206]

Little additional information about the proposals has been made available. The project will likely be viewed by some as an improvement on past WCWCD recommendations--especially those projects calling for water development above Zion National Park or atop abandoned oilfields. It is also certain, however, that the project will be scrutinized for possible adverse impacts on wildlife, natural stream regimes, cultural resources, and so on. Other critical issues, such as economic costs and the viability of non-structural alternatives, shall also play a part as this proposal is reviewed.

Cedar City Transbasin Diversion

Increasing M&I demand in Cedar City, Utah is leading many water planners in that city to look to the Virgin River for future water supplies. After the Dixie and Warner Valley projects collapsed, Cedar City and WCWCD in 1984 signed an agreement where the former, in exchange for paying some costs associated with the Quail Creek project, would receive rights to Upper Virgin basin water. Cedar City's supply would come primarily from Kolob Reservoir (in which Cedar City has 40% interest[207]) and Crystal Creek.[208]

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[205] Utah Division of Water Rights. Filing for Water in the State of Utah: Application to Appropriate Water. Application #A66956, #A66955, #A66957 respectively (undated).

[206] Utah Division of Water Rights. Filing for Water in the State of Utah: Application to Appropriate Water. Application #A66943, #A66944, #A66991, #A66945 (undated).

[207] Cedar City paid 40% of Kolob's construction costs in the 1950s, with the understanding that it would obtain the entire storage capacity of that reservoir once the entire Dixie Project was completed. Abandonment of the Dixie Project led to the need to find a substitute reservoir. Planners investigated eight sites in the Virgin North Fork area during the 1970s, again under the assumption that completion of a North Fork dam would allow Cedar City to then claim the entire Kolob supply. However, attempts to site a dam there have been unsuccessful, leading to the present-day situation.

Since Cedar City is not located within the Virgin River basin, any water project involving the Virgin would obviously require a transbasin diversion. Under the 1984 agreement, however, Cedar City is provided the alternative to divert some 6100 acre-feet yearly from two Upper Basin springs--Upper Mill Creek and Three Creek, which feed tributaries to the Virgin North Fork--in the event that a transbasin project is determined to be infeasible.[209] Cedar City has until November, 1993 to select an option. If it declines to pursue either alternative, WCWCD will be required to reimburse its costs on Quail Creek and buy out the city's interest in Kolob Reservoir.

Seven alternatives within the two scenarios discussed above are currently under consideration.[210] All of those alternatives would include a power generation component, the revenues of which would offset some of the project costs. Construction of a treatment plant to provide water for domestic uses would be required for all but two of the alternatives.[211]

Despite Cedar City's ongoing interest in the transbasin diversion project, relatively few details regarding potential dam and diversion locations, engineering, conveyance structures, and other issues have been available. A March 1993 report prepared for Cedar City by Bingham Engineering describes thirteen options for Cedar City's water future--including several alternatives that would require water importation from the Upper Virgin

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[208](...continued)
[208] Cedar City Transbasin Study, at 45.

[209] Cedar City Transbasin Study, at 23.

Cedar City would be allowed a maximum of 533 acre-feet per month during the summer. Note that these springs also supply private water rights applied to irrigation and livestock watering in the basin. Any adverse impacts on these rights would have to be mitigated if Cedar City decides to act on this alternative.

[210] See Figure 27. Compiled from Cedar City Transbasin Study.

[211] Cedar City Transbasin Study, at 23.

River basin.[212] Environmental and economic concerns receive only superficial treatment in Bingham's report, however, so possible adverse impacts are little known at this point. Many of these questions will be addressed when and if studies to determine a particular project's feasibility are initiated.

Virgin River Headwaters (Sites #6 and #7)

North Fork of the Virgin River

Despite the area's proximity to Zion National Park, water managers have for years eyed the possibility of a dam and reservoir on the North Fork.[213] A WCWCD study completed in 1980 on the so-called Bulloch damsite calls for a dam and 10,000 acre-foot reservoir to be located less than two miles from the eastern border of Zion.[214]

As described earlier, the North Fork of the Virgin enters Zion National Park and flows through "The Narrows," a world-renowned hiking trail.[215] Dam construction upstream from the park, however, would change the flow regime of water entering The Narrows, in turn affecting water temperature, sediment loading levels, erosion events, and peak flow/flood episodes. Additionally, a dam could block access to The Narrows from the park's eastern boundary, limiting hiker access to routes from within the park. Recreationists would also be threatened with the possibility of occasional flood-level releases from the dam, and there thus exists the possibility that liability concerns could force the park to close The Narrows to hikers. Also of concern would be the damsite's impact on Zion's other

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[212] The Deep Creek Tunnel project is the same as Alternative C-3 in the Cedar City Transbasin Study. Cedar City Evaluation, at V-39. Six other alternatives, including those that would take water from Kolob Reservoir or from the proposed Urie Creek Reservoir, are found to have a high potential for conflict with Zion National Park's reserved water rights. Id., at VI-10.

[213] Preliminary Damsite Analysis, at 62.

[214] Bingham Engineering Bullock Dam Preliminary Design Report (1980).

[215] In 1981, The Narrows region supported 557 visitor days; in the last decade, that number has increased to annual 7444 visitor days. Vieira, Vic. Division of Resource Management and Research, Zion National Park: Annual Report (1992) [at 30].

resources, including the ongoing geological processes that formed the spectacular canyons and other landmarks throughout the park, as well as the reserved water rights now being asserted by Zion officials.[216] Research by Valdez shows that populations of Virgin River spinedace do inhabit the North Fork as far upstream as Orderville Canyon,[217] but the possibility of adverse impacts to this potentially listed species are as yet undetermined. Finally, dam construction could obviate potential wilderness designation of the North Fork of the Virgin.

Controversy surrounding the North Fork site is bound to heat up following WCWCD's application, submitted in late February, 1993 to the Utah Division of State Lands and Forestry, to purchase almost 900 acres of state land adjacent to Zion National Park and within reach of the North Fork of the Virgin River.[218] Despite requests from the environmental community, the Bureau of Land Management responded only lukewarmly to requests that it work with its sister agencies in the Department of Interior, particularly the National Park Service, to develop a trade package of other federal lands that it could provide to the state in order to bring those parcels into federal control and thus protect them from the threat of water development. Before WCWCD can purchase the land, the State Lands Division must determine the fair market value of the property, and then make that property available to the bidder offering the greatest dollar amount in excess of the fair market value.

East Fork of the Virgin River

As many as eleven different dam sites on in the Virgin East Fork region have been investigated at one time or another.[219] Most recent studies, including initial WCWCD

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[216] Interview with Donald Falvey, Superintendent, Zion National Park, December 17, 1992. Concerns regarding Zion's reserved rights would of course also apply to dambuilding proposals on the East Fork of the Virgin as well.

[217] Valdez Report, at 33.

[218] Utah Division of State Lands and Forestry. Application for the Purchase of State Land (February 5, 1993).

[219] Preliminary Damsite Analysis, at 5.

geological surveys completed in 1986, have focused on the so-called Parunuweap site. Preliminary reviews of the site have suggested the construction of a dam and 40,000 acre-foot reservoir at a site about five miles from the border of Zion National Park.[220]

The East Fork proposal is similar to the North Fork plan discussed above in that a damsite near this region of Zion would adversely impact access to, and use of, an important recreational area--in this case, Parunuweap Canyon, which is both a scenic hiking route and potential wilderness area.[221] Another potential problem concerns the canyon's rich archeological resources. Though a thorough inventory has yet to be completed, existing studies have determined that over 85 significant sites may lie in the section of Parunuweap running through Zion.[222] Depending on the location of the dam, the reservoir pool size, and other factors, it is possible that some of these sites could be flooded or otherwise damaged.

Finally, officials at Zion intend to designate the East Fork region as a Research Natural Area (RNA). The Parunuweap RNA would be the focus of research on several subjects, including streamside vegetation, migrant bird populations, and the newly-listed Mexican spotted owl.[223] Successful research will of course depend in no small part on the assurance that natural flows remain in place on the East Fork.

Beaver Dam Wash (Site #2)

The Beaver Dam Wash flows from Nevada and into Utah, and then into Arizona and its confluence with the Virgin. It also straddles three lifezones: the Sonoran, the Colorado

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[220] Creamer and Noble Engineers, Inc. Preliminary Investigation: East Fork of Virgin River Dam Sites (1986).

[221] A Zion National Park study shows that Parunuweap gets relatively little visitor activity--only about 500 visitor days in 1991. Vieira, at 5.

[222] Wilderness at the Edge, at 114.

[223] Vieira, at 7.

Plateau, and the Great Basin.[224] Because of its transitional nature, the Beaver Dam Wash region is rich in biological diversity, and contains habitat for a number of unusual species, including the desert tortoise and a variety of other rare birds and reptiles.[225] Due to these and other attributes--not the least of which the fact that it is primarily devoid of human impacts--the UWC has proposed that a little less than 25,000 acres of Beaver Dam Wash be designated as wilderness.[226]

The Beaver Dam Creek is an intermittent stream running through the proposed wilderness and entering the Virgin River near the town of Littlefield in the Arizona Strip. It contains stretches of excellent spinedace habitat, as well as two populations of the sensitive fish.[227] As one of the few waterways in the region, it also contains critical riparian resources.[228]

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[224] Wilderness at the Edge, at 92.

[225] Brigham Young University's Lytle Ranch on Beaver Dam Wash hosts more than 180 bird species. Several reptile species that occur in the area are found nowhere else in Utah; the region also supports a number of small mammals and rodents. Wilderness at the Edge, at 96.

[226] Wilderness at the Edge, at 94.

Some have suggested that Beaver Dam Creek itself may be eligible for WSR designation. Cedar City District Manager Gordon Staker noted recently that "[i]n my judgment the Beaver Dam Creek and setting was of wild and scenic quality. File memo, Gordon Staker, District Manager, Cedar City District (August 7, 1992).

[227] Valdez Report, at 22.

[228] Like the Virgin, Beaver Dam Wash is included in the Arizona Strip's list of priority riparian areas. Strip RMP, at III-18. It is also on Utah BLM's acquisition list for meeting instream flow needs. Dixie RMP, at 117-118.

The area's riparian qualities are also not lost on the Cedar City District: "Riparian vegetation [at "The Narrows" in Beaver Dam Wash] consisted of cottonwood trees of all sizes and heights, several species of willows, several species of grasses and sedges and other species of plants. The riparian zone appeared to be in an improving trend based on the age and species mix of the vegetation." Staker memo (August 7, 1992).

The WCWCD has applied for water rights on the Beaver Dam Wash. The Conservancy District is seeking to claim some 40,000 acre-feet and construct, possibly in conjunction with Nevada water interests, a 400-acre, 26,000 acre-foot reservoir at a site near Motoqua, Utah. Water stored in the proposed Beaver Dam Reservoir would be conveyed by pipeline to a WCWCD-owned treatment facility and then provided for domestic, municipal, and (perhaps) power production needs in the region.[229]

Also at risk in the Beaver Dam Wash region is the Lytle Ranch Research Preserve, operated by Brigham Young University. Lytle Ranch is situated on one of the few perennial sections of the Wash, and is dependent on those flows to support the wildlife resources maintained there. Depletion of surface and groundwater, as would occur should these development proposals come to fruition, could impact wildlife, riparian zones, and research opportunities afforded by the facility.

Fort Pearce Wash (Site #4)

The Washington County Water Conservancy District has also forwarded a water rights application and, with it, a plan to construct a dam and huge offstream reservoir--occupying almost 2730 acres and storing 135,000 acre-feet--in the Fort Pearce Wash region of the basin.[230] Like the Beaver Dam Wash proposal discussed above, the water would be pumped from the reservoir to a WCWCD treatment facility and applied to domestic, municipal, power, and recreation uses.

There is concern that the area's geology could complicate the project's construction and maintenance. Because of the site's probable location in Moenkopi or Shinarump formations, there are potential problems with gypsum deposits, open joints or fractures, and

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[229] Utah Division of Water Rights. Filing for Water in the State of Utah: Application to Appropriate Water. Application #A65091 (undated).

[230] Utah Division of Water Rights. Filing for Water in the State of Utah: Application to Appropriate Water. Application #A65118 (undated).

soil porosity.[231] According to SCS, concerns regarding the Fort Pearce Wash site would stem from the fact that it lies atop the Warner Ridge trend, giving it essentially the same geological framework as the Quail Creek site.[232]

Additionally, its proximity to Chinle, Moenave, and Entrada formations provides reason to believe that erosion--and thus high siltation rates--could impact reservoir operation.[233] As the soils in the Fort Pearce region tend to be both highly erodible and salt-laden, there is the expectation that high salt sediment yields could occur in the stream and in the general area. Unless erosion in the area is controlled somehow--a difficult task, since the erosion is naturally-occurring, rather than linked to human impacts--salty sediment would be trapped by the reservoir, an outcome which would in turn affect water quality, water quantity, and dam safety, and make the project a net contributor to the Virgin's salinity levels.[234]

Besides geological concerns, there remains the fact that the site could adversely affect the Fort Pearce State Historical Site, which is listed on the National Register of Historic Place. UDWR, though it has not yet completed a survey, also expects that some archeological resources are present at the Fort Pearce site.[235]

Cooperative Water Project (Site #1)

Like many other cities of the southwest United States, Las Vegas has seen its population--and its collective thirst--expand greatly, especially throughout the 1980s. To meet expected shortfalls, Clark County plans to import thousands of acre-feet of water each

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[231] Preliminary Damsite Analysis, at 84. The document notes that "[t]he fractured nature of the abutments may require extensive grouting"--that is, the same repair procedure that was attempted at Quail Creek before its failure.

[232] Interview with Robert Raeseley, United States Soil Conservation Service, December 1992.

[233] Preliminary Damsite Analysis, at 87.

[234] Raeseley interview.

[235] Preliminary Damsite Analysis, at 88.

year and to institute certain conservation measures. Many of these changes come under the aegis of the Cooperative Water Project (CWP), a massive transbasin water development proposal spanning four counties and 20,000 square miles. The CWP is expected to someday yield 255,000 acre-feet annually.[236]

A great deal of controversy has already arisen regarding the CWP generally. In July 1992, voters in rural White Pine County, Nevada agreed to fund, via a five-year surtax, a legal fund to defend local water supplies from Las Vegas's "water grab."[237] Additionally, water applications made by LVVWD to supply its CWP plan have been met by some 3600 citizen protests.[238] There have also been outcries that Las Vegas must revisit its traditional water use habits. Mifflin Associates, hired by three rural Nevada counties, has already suggested several alternatives to CWP, including the use of treated wastewater, Colorado River water, urban conservation, obtaining upstream or downstream farm water, leasing water from Native American rights holders, cloud seeding, and water exchanges with California.[239]

An important component of this proposal involves the import of 70,000 acre-feet of Virgin River water each year--either 70,000 acre-feet from the Virgin only, or 60,000 acre-feet from the river and another 10,000 acre-feet from underground water supplies.[240] The

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[236] LVVWD Environmental Report, at 2.

[237] Garrett, JoAnne. "Rural County Fights Vegas Water Grab." Citizen Alert, Fall 1992, at 1.

[238] Benezet (Fall 1992), at 9.

[239] Bird, Mark. "Possible water project price tag: $12.4 billion." The Daily Spectrum (December 29, 1992).

[240] LVVWD Environmental Report, at ES-1.

The Southern Nevada Water Association--composed of LVVWD, the Big Bend Water District, the Clark County Sanitation District, and the cities of Henderson, Las Vegas, North Las Vegas, and Boulder City--recently applied for two additional water rights on the Virgin River. The first calls for 113K af, and involves a development scenario essentially the same as that envisioned in the Cooperative Water Project. Southern (continued...)

area under study for this segment of the CWP includes the Virgin River as it flows from the Arizona state line to Lake Mead. It also includes a pipeline corridor alongside Interstate 15 between Riverside and Las Vegas. In general, the plan would require construction of a new diversion dam on the lower Virgin, most likely in the Halfway Wash area six miles upstream from Lake Mead. Also required would be off-channel storage (also assumed to be in the Halfway Wash area), as many as fifteen high-capacity alluvial groundwater wells, a water treatment plant, four pump stations, and 75 miles each of pipelines, access roads, powerlines, and telemetry facilities. It is expected that this project alone could provide 48,000 acre-feet of potable water yearly.[241]

Using the Nevada stretch of the Virgin River for culinary purposes will, of course, require that the water be processed in a desalinization plant prior to consumption. This requirement, though expensive on its face, may in truth be the project's economic saving grace. Surface and groundwater from the Virgin Valley carries about 426,000 tons of salt to the Colorado River annually.[242] Desalinization of Virgin River water, however, would purportedly lower that salt load by about 200,000 tons yearly.[243] Reduced salt loading is an important objective of Colorado River management, as the river serves some 18 million M&I users in seven states, as well as the irrigation needs on 1.7 million acres of agricultural land.[244] A 1972 amendment to the Clean Water Act[245] requires immediate action toward

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[240](...continued)
Nevada Water Authority. Water Right Application Number 58590 (March 9, 1993).

The second calls for 150K af of water to be removed from Lake Mead itself and processed through existing water treatment facilities--a scenario that, while much more acceptable from an environmental viewpoint, would necessitate renegotiation of the Colorado River Compact. Southern Nevada Water Authority. Water Right Application Number 58591 (March 9, 1993).

[241] LVVWD Environmental Report, at 8.

[242] LVVWD Plan of Study, at 34.

[243] LVVWD Environmental Report, at ES-5.

[244] LVVWD Plan of Study, at 4.

reducing the salt content of the Colorado, and also mandates the formation of the Colorado River Salinity Control Forum to develop and implement salinity standards. Control programs now in place remove about 230,000 tons of salt from the river each year; removal of an additional 1.3 million tons annually will be required to meet future standards.[246]

By serving a combined purpose--reducing salt loading in the Colorado while addressing the projected water needs of the Las Vegas Valley--LVVWD's proposal will likely be eligible for cost-sharing funds from the Lower Colorado River Basin Development Fund for salinity control-related costs.[247]

According to a Bureau of Reclamation/LVVWD study, a salinity control project of this magnitude must be combined with some other service in order to be economically feasible.[248] As the review of this proposal progresses, it should become clear whether or not the dual goals of LVVWD are compatible.

Still at issue, however, are the possible effects of LVVWD's proposal on the Virgin River's resources. These potential impacts are difficult to assess, given the general lack of information about the proposal. For example, LVVWD expects that some 309 acres of wetlands will be affected by construction of the dam and reservoir, as well as by eventual inundation at both sites. Given that these acres account for less than 4% of the Virgin River-based wetlands in the region, it is LVVWD's contention that this particular impact may be minor. However, it is difficult to judge the severity of the impact without, among other

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[245] Colorado River Basin Salinity Control Act, PL 93-320, Title II.

[246] LVVWD Plan of Study, at 6.

[247] Cost estimates for the CWP range from $2 billion (LVVWD estimate) to as much as $12.4 billion (Mifflin and Associates). Bird (December 29, 1992). Mifflin, which was hired by three rural Nevada counties to review the CWP, notes also that acre-foot costs for the project could be as high as $1000--not including the costs of desalinization, environmental mitigation, inflation, or pumping.

These figures led Mifflin to conclude "Capital costs for each phase [of the project] are large enough that there is some question as to the feasibility of private sector financing at realistic rates."

[248] LVVWD Plan of Study, at 2.

things, knowing what other projects may be anticipated in the area, how many wetland acres have already been lost, or the degree of importance these specific wetlands possess. Should other wetland-harming proposals be realized sometime in the future, the overall, *cumulative* impacts on the region's wetlands could be significant. Additionally, upstream development could substantially diminish stream flows and affect annual flow regimes, which in turn could result in the loss of peripheral alluvial wetlands. LVVWD notes that wetland losses could possibly be offset by the development of wet areas around both the diversion reservoir and the storage reservoir.[249] The health of these "new" wetlands--and their ability to support a diverse population of desert wildlife--is not certain enough at this point to make a confident choice possible. Generally speaking, however, attempts to "create" wetlands tend to meet with little success.

Likewise, much about potential wildlife impacts is to be learned. Certain species, such as birds that depend on open water habitat, could in LVVWD's view actually benefit from the two reservoirs formed as part of the project. This potential benefit must be weighed against the adverse impacts that threaten other components of this fragile, desert ecosystem. Again, the optimistic scenario provided by LVVWD only tells part of the story--there is no analysis in any planning document that fully addresses the concerns of direct habitat loss, adverse construction impacts, loss of streamside vegetation, and so on.

The situation is no more clear regarding impacts on land-based wildlife. Numerous amphibians, reptiles, and large and small mammals face various threats, both during and after project construction: direct loss of individuals, loss or degradation of habitat, increased take due to human contact, noise impacts, and so on.[250]

The existence of special status species at or near the project site could influence decisions regarding the construction and operation of the project. Although LVVWD has not yet completed the required rare species surveys, it notes that some 20 sensitive species may be present in the proposed project area. Three of these--bald eagle, peregrine falcon, and

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[249] LVVWD Environmental Report, at 85.

[250] LVVWD Environmental Report, at 95.

desert tortoise--are federally protected. While the eagle and the peregrine may be only occasional visitors to the project area, the desert tortoise depends on sites near the proposed reservoir, the desalinization plant, the evaporation ponds, and the pipeline rights-of-way for critical habitat. Potential impacts on the protected species include destruction of individuals, illegal collecting or shooting, loss and/or fragmentation of habitat and forage, as well as dislocation of individuals.[251]

As noted above, the Virgin River also plays a critical role in the future survival of four rare fish species: the woundfin minnow, the Virgin River spinedace, the Virgin River chub, and the flannelmouth sucker. LVVWD's preliminary study of these four fishes shows that they are limited to habitat relatively far upstream from the dam/diversion area, and thus not likely to be affected by the project. Other studies, however, have found populations and/or habitat as far downstream as Lake Mead.[252] If populations within the project's reach are found, they could be subject to loss of habitat, changes to runoff and flow patterns resulting from construction and operation, impaired water quality, and the like. It is not clear if this threat to native populations would be fatal to the project, or if the project would be allowed to continue under mitigation requirements outlined in a biological opinion like the one utilized at Quail Creek.

A related concern is the project's impacts on the non-native fish species, like the red shiner and the mosquitofish, that compete with these rare species for food and habitat. Should reservoir construction enhance habitat for these exotic fishes, concurrent loss of the

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[251] LVVWD Environmental Report, at 53 and at 113.

Bald eagles are protected under the Endangered Species Act, the Migratory Bird Treaty Act [16 U.S.C. §§703-712], and the Bald and Golden Eagle Protection Act [16 U.S.C. §§668a-668d]. Peregrine are protected under both ESA and MBTA, while the desert tortoise is listed as endangered under ESA.

[252] LVVWD Environmental Report, at 115. Native fishes have been detected as far downstream as Halfway Wash in the course of Department of Interior studies on the Virgin.

rare, imperiled fishes could result unless measures to prevent the former from claiming rare fish habitat are taken.[253]

As is the case with rare wildlife species, LVVWD has not yet initiated surveys required for reviewing the status of rare plants in the area. At least twelve sensitive plants, four of which--Geyer milkvetch, sticky buckwheat, rosy bicolored beardtongue, and barrel cactus--receive state-level protection, could or do occur at the project site. These plants could suffer impacts from inundation, construction, and so on equivalent to those that threaten wildlife. Avoidance of rare plant areas, transplanting, seedbed protection, and habitat restoration could mitigate these damages, according to LVVWD.[254]

A review of LVVWD's proposal indicates that several other public land assets may pay a price if it is implemented. The region's rich store of cultural resources is of particular concern. A variety of sites along both the Virgin and the Muddy River could be affected by inundation, vehicle damage, or illegal collection made possible by increased access.[255] Although the potential for such conflict is high, LVVWD has not yet offered a plan to prevent, or even to mitigate, such damage.

Plans to limit impacts on nearby special management areas are also uncertain. The proposed project would be constructed near Nevada's Valley of Fire State Park, the Overton State Wildlife Management Area, and Lake Mead National Recreation Area. Effects on recreational visitation to each area and on each area's wildlife resources, for example, must be considered. Likewise, the fact that the dam/diversion is expected to deplete flows into Lake Mead by at least 70,000 acre-feet annually is of concern.[256] Officials at the Overton

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[253] LVVWD Environmental Report, 116. According to LVVWD, it is also possible that the diversion dam could serve as a barrier and thus prevent exotics from moving upstream where they would compete with native populations.

[254] LVVWD Environmental Report, at 106.

[255] LVVWD Environmental Report, at 118.

[256] LVVWD Environmental Report, at ES-5. LVVWD points out that if return flows are factored in, the depletion is more along the lines of 38,000 acre-feet yearly. Id., at 11.

Management Area have voiced their concerns with the LVVWD project, primarily regarding the fact that the project will deplete the river for more days each year.[257]

The LVVWD project is currently in the preliminary planning stages. A complete investigation by the Bureau of Reclamation, including the development of an environmental impact statement, is expected in mid- to late-1995. An initial Feasibility Study for the Halfway Wash proposal, prepared jointly by BuRec and LVVWD, was released in April 1993; however, its focus on an approach that would result in further depleting the Virgin River is unacceptable to river conservationists, who have recommended that the agency review and implement non-structural approaches to meeting demand instead of again wandering down the well-worn pathway of continued dambuilding.

LVVWD's attention would be better rewarded should it decide to work on schemes to pull water from Lake Mead directly. Though this would likely require amendment of the Colorado River Compact, a decision to wheel water through the lake would eliminate many of the proposed project's adverse impacts upon the lower Virgin River. Special status species and their habitats, recreational values at Overton Bay, and the health of the river channel itself--to name but a few--would enjoy a margin of safety not available should LVVWD choose to pursue those alternatives that would remove water from the river. In addition, Nevada water interests and their customers could, under the wheeling alternative, evade the high economic costs that will surely accompany any diversion, desalinization, and transportation project.[258]

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[257] Padilla interview. Padilla also notes that reservoir storage could also be used to supply flows in drier times--though of course these flows would not mirror natural flows and thus could adversely affect wildlife, channel integrity, water quality, etc.

[258] The Department of Interior's Assistant Secretary of Water and Power has already stated that Nevada's plans to develop the Virgin may be infeasible due to the projected economic costs, and that the proposal may in fact not be implemented. Interview with Betsy Rieke, Department of the Interior, Washington, D.C., July 13, 1993.

Quail Creek Management Practices

The adverse environmental impacts arising from the construction of the Quail Creek complex have not been limited to the sorts of inherent problems outlined above, or to the devastating impacts realized after the dike burst in 1989. In fact, *status quo* management of the site may be contributing to the significant decline of native fishes in those reaches of the Virgin downstream from Quail Creek.

First, at least one observer has expressed continuing concern with the geological stability of the site, particularly regarding that of the main dam. As noted above, Quail Creek's location in the Shinarump Conglomerate places it in contact with a number of leaky, porous, and highly-fractured structures. As the main dam is located in an anticline area, it is stressed against a series of smaller folds and faults, making another failure like that of 1989 possible.[259]

Though the offstream nature of Quail Creek would supposedly protect mainstem resources, several attributes--particularly native fish populations--have shown severe decline over the years of the site's operation. The biological opinion issued for the Quail Creek project for the purpose of woundfin minnow protection required that a minimum flow of 86 cubic feet per second (cfs) pass by the Quail Creek diversion structure, unless natural flows were less--in which case the diversion structure would not be operated at all.[260] Further, if flows at the Washington Fields diversion were found to be less than 86 cfs, releases from the Quail Creek reservoir would then be required as a supplement.[261]

However, flows at the diversion have consistently been measured at levels far below the 86 cfs required by the no jeopardy opinion. According to FWS, in fact, the flow requirement may have been violated during as much as 80% of the diversion's operation in

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[259] Raeseley interview.

[260] Memo from Cedar City BLM District Manager to Assistant Field Supervisor, Fish and Wildlife Enhancement [hereinafter FWS Quail Creek Memo] (October 21, 1991).

[261] Deacon (1988), at 19.

1985 and 1986.[262] U.S. Geological Survey measurements at the Virgin River gage above Quail Creek taken between October, 1988 and September, 1993 show numerous instances where daily mean flows fell below the required 86 cfs.[263]

Water quality also deteriorated from the pre-Quail Creek days; conductivity increased throughout the Utah segment of the Virgin, while water temperature and turbidity declined above the project site. By 1985, apparently, water quality in 50% of the river's woundfin habitat did not meet the conditions required in the biological opinion.[264]

These continued "gross violations," as they were characterized by the agency, allegedly reduced populations across all life stages of both woundfin minnow and Virgin River Chub, thus leading to illegal takes and possible Endangered Species Act violations.[265] Because of these declines--and also because of the decision to list the Virgin River chub--the federal government decided in October, 1991 to reinitiate Section 7 consultation regarding operation of the Quail Creek complex.[266] This intent was reaffirmed in March, 1992 when BLM's Cedar City District informed FWS that "[w]e agree that certain conditions [at Quail Creek] have changed, that the endangered species in the Virgin River continue to have

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[262] FWS Quail Creek Memo, at 2. FWS also found that when natural flows dropped below 86 cfs, up to 47% of the Virgin's flow was still diverted to the Quail Creek reservoir.

[263] See Figure 28, which duplicates USGS data for the gage above Quail Creek.

[264] Deacon (1988), at 20.

Deacon also notes increases in both tapeworm incidence and red shiner populations after 1985. The latter, according to Deacon, may have arisen due to the lack of flash floods apparent in the Quail Creek region after 1985.

Additionally, an April 1992 letter from the FWS Assistant Field Supervisor for Fish Enchancement to the BLM's Cedar City District FWS cites the former's concerns regarding interference with natural flows and/or water temperature decreases and how those changes in the river's natural regime may be affecting native fish.

[265] FWS Quail Creek Memo, at 2.

[266] FWS Quail Creek Memo, at 1.

problems, and that there is enough question regarding the operations of this project to warrant additional review."[267]

Groundwater Threats

Water developers also have demonstrated interest in the Virgin River basin's groundwater supplies. For instance, several water entities have tendered applications in the groundwater-rich Beaver Dam area.[268] The Mesquite Farmstead Water Association (MFWA) has purchased land near the town of Beaver Dam, Arizona and filed with AZDWR for a right that would transport water to Mesquite. MFWA envisions a $1.3 million, 3000 gallons/minute pipeline that would route groundwater from the Beaver Dam Wash aquifer. The town of Littlefield, among others, is concerned that the Mesquite project would deplete existing irrigation and domestic wells. The Arizona Department of Fish and Game, as well as FWS, has also voiced opposition to the Mesquite plan because of possible impacts on surface flows in the Wash.[269] BLM has also filed for instream flow rights in the same area.

Other pressures abound. An entity known as Washington Land and Cattle has filed at least nine applications--a total of almost 100 cfs--for the right to pump groundwater from some 2500 acres of Utah state trust lands in the Joshua Tree and Beaver Dam Slopes proposed wilderness units.[270] Another organization, Dutchman Draw, has filed four

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[267] Letter from Gordon Staker, Cedar City District Manager, to Clark D. Johnson, FWS Assistant Field Supervisor (March 19, 1992).

[268] The United States Geological Survey (USGS) intends to conduct a study on Beaver Dam Wash in order to assess groundwater supply and hydrological relationships. According to USGS, the study, which is jointly sponsored by all three basin-region BLM resource area offices, is currently on hold while the agency seeks clearance to work in desert tortoise habitat. Interview with George Piper, United States Geological Survey, April 8, 1993.

[269] "Arizona seeks share of Virgin River system." Arizona Water Resource. Water Resources Research Center: Tucson, AZ (March 1993) [at 1].

[270] Letter from Lynn Allred, Director, Washington Land and Cattle, to Robert L. Morgan, State Engineer, UDWaterR, December 19, 1991.

applications (for 49 cfs) in Washington County.[271] The cities of St. George, Ivins, and Santa Clara have forwarded a joint application, also for 49 cfs of groundwater.[272] These filings in turn led several Utah users to also file for rights on remaining unappropriated waters in the drainage.[273] This rush to develop groundwater could, of course, deplete critical stores of water; equally important is the fact that large-scale groundwater mining could also impact those surface waterways hydrologically connected to natural underground reservoirs.

The general threats to river resources posed by all dams, along with the specific threats attributable to the proposals outlined in the preceding pages, are of concern because of their potential impacts on overall river health. While these dam proposals are obviously important in and of themselves, environmentalists are often forced into the position of reviewing them--and often opposing them--on a "brushfire" basis. Environmentalists' attention, then, is often forced away from the opportunity to consider the more fundamental issues of how and why dams and other structural proposals are born and implemented.

Likewise, environmentalists are often discouraged from suggesting water management approaches that depart from the traditions now in place on the Virgin River. A proactive response to institutional failures is therefore necessary.

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[271] Utah Division of Wildlife Resources. Virgin River Drainage Water Rights [database printout] (February 11, 1992).

[272] Webb, Loren. "Cities scramble to secure water rights." The Daily Spectrum (April 19, 1991).

[273] "Beaver Dam Wash Besieged." Southern Utah Wilderness Alliance (Summer 1991) [at 11].

Chapter V

Legal Approaches to Protecting the Virgin River

There are a variety of statutory and regulatory approaches available to the myriad state and federal agencies, interdisciplinary task forces, and conservationists working to protect instream flows and related resources. Implementation of these strategies, however, is only at its crudest stage, and lags far behind--both in terms of success and, in many cases, in terms of public acceptance--the protections afforded consumptive uses by tradition, by the water management bureaucracy, and by the strength of the prior appropriation doctrine.

Section 404: Wetlands And Riparian Area Protection

Protection of the important wetland and riparian resources of the Virgin, and thus of the wildlife and other ecological values dependent on the river, is generally realized through Section 404 of the Clean Water Act.[274] The core of Section 404 is its prohibition against projects discharging dredged or fill material into navigable waters without a permit. Permits are issued by the Army Corps of Engineers in consultation with both the Environmental Protection Agency (EPA) and FWS, and can be denied if a particular project would cause or contribute to an "unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas."[275] Substantive criteria for permit issuance, including restrictions in any particular area, are developed by EPA.[276]

The ACOE may in some cases choose to delegate its permitting authority to the states via the issuance of a general permit.[277] The general permit in turn authorizes discharges of

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[274] Federal Water Pollution Control Act (FWPCA), 33 U.S.C. §§1251-1387. Guidelines for the protection of wetlands and riparian areas are described at 33 U.S.C. §1344.

[275] 33 U.S.C. §1344(c).

[276] 33 U.S.C. §1344(c).

[277] 33 U.S.C. §1344(e).

dredged or fill material provided that the state issues a stream alteration permit. Generally, projects covered under state permits include bank stabilizations and cofferdams; general permits cannot be applied to work in wetlands, in endangered species habitat, or near historic sites.[278] The Utah Division of Water Resources, which has been delegated permitting responsibility in that state, received at least twenty stream alteration permits on the Virgin River drainage in 1991 and 1992 for projects including bridge reconstruction, trail maintenance, and wildlife habitat enhancement.

A review of Section 404 permits issued over the last ten years for the Virgin River shows several instances where actions normally requiring a permit, such as work in endangered species habitat, were initiated before the ACOE could review them for Section 404 compliance. For example, one project failed to secure a Section 404 permit before discharging fill material and constructing a dike on the Virgin near St. George--this despite the existence of both woundfin and Virgin River chub in that stretch of the river.[279] Another unauthorized fill project on the Virgin threatens both endangered fish and several cultural resources.[280]

The ACOE in several instances responded to these violations by issuing "after-the-fact" permits when operators failed to seek the proper permission before beginning work that could very well have adversely impacted the Virgin. ACOE files show at least six after-the-fact permits were issued--five of those issued for projects in endangered species habitat--despite FWS's oft-repeated contention that it does not "condone" their use, given the potential for adverse impacts on native fish.[281] While individual actions may not present a significant risk,

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[278] U.S. Department of the Army. General Permit 040, State of Utah. October 23, 1992.

Examples of activity recently approved under Utah's general permit include bridge replacement over the Virgin North Fork (Stream Alteration Permit Application #92-81-10SA), bank erosion control on the Virgin East Fork (Application #91-81-04SA), relocation of a gas pipeline (Application #91-81-10SA), and sewer line replacement (Application #90-81-18SA).

[279] ACoE file #9516, Salt Lake City office.

[280] ACoE file #9886/E87-062, Salt Lake City office.

[281] ACoE file #9559/E86-042, Salt Lake City office.

the cumulative impacts of these agency failures could indeed constitute a threat to endangered wildlife and other river-related resources.

While the Clean Water Act holds out some promise of protection of the Virgin's most important resources, its implementation has often fallen short of that goal.

Federal Reserved Water Rights

The doctrine of "federal reserved water rights" notes simply that public lands reserved by the federal government implicitly carry with them the right to an adequate supply of water to meet the statutory purposes of that reservation.[282] First announced by the Supreme Court in 1908 to apply to Indian reservations,[283] the reserved rights doctrine has since been expanded to apply to national parks, recreation areas, and monuments, as well as national forests, national wildlife refuges and wilderness areas.[284]

Reserved rights are of an indeterminative nature, and become fully apparent and functional only when the federal government chooses to assert a reserved claim. Reserved claims also are not bound by the prior appropriation requirements of diversion and application to beneficial use. Rather, the right simply exists from the date of reservation and can be

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[282] A federal "reservation" is an area of federal land withdrawn and dedicated to an immediate and predetermined purpose. Warin, S. and K. Samelson, "Non-Indian Reserved Rights," 58 Denver Law Journal 783 (1981).

[283] Winters v. United States, 207 U.S. 564 (1908).

[284] Arizona v. California, 373 U.S. 546 (1963) explicitly mentions national recreation areas, national forests, and national wildlife refuges as carrying federal reserved rights. Cappaert v. United States, 426 U.S. 128 (1976), expanded that list to include national monuments.

A series of cases argued in the mid-1980s--Sierra Club v. Block I [615 F.Supp. 44 (1985)], Sierra Club v. Block II [622 F.Supp. 842 (1985)], and Sierra Club v. Lyng [661 F.Supp. 1490 (1987)]--extended reserved rights to wilderness areas. These rights were revoked via the Tarr Opinion [U.S. Department of the Interior memorandum M-36914 (Supp. III) (July 26, 1988)]. However, the strength of the opinion leading to that revocation is doubtful. See Tristan, M. Gloria. "Comment: Interior Turns Off the Tap for Wilderness Areas." 29 Natural Resources Journal 877 (1989).

asserted by the federal government at any time of its choosing. Until that point, the reserved right remains dormant in terms of its effects upon other appropriators.

A number of federal reservations have been made in the Virgin River corridor: Zion National Park, at the headwaters of the river; Lake Mead National Recreation Area, at the river's mouth; the Dixie National Forest, also at the headwaters; the Virgin River Gorge Recreation Area; and the Beaver Dam Mountains Wilderness Area. Officials at Zion are now in the process of asserting the park's reserved rights. Research is currently underway at the National Park Service center in Fort Collins, Colorado to quantify those rights as part of the ongoing Virgin River adjudication. As regards Zion, whose priority date extends back to 1909 when it was initially reserved as Mukuntuweap National Monument,[285] the assumption is that the quantification will be based on non-impairment criteria, meaning simply that any activities to remove water from the park and/or interfere with natural flows into the park by storing water upstream will be allowed only if they do not impair park resources.[286]

At the other end of the river, representatives of the Lake Mead National Recreation Area are also working toward protecting reserved rights. Though the Virgin runs through less than two and one-half miles of the NRA, it constitutes an important recreational resource. As the river is one of only three nutrient-rich watercourses still flowing into Lake Mead, it provides

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[285] Presidential Proclamation No. 877, 36 Stat. 2498. The area was renamed Zion National Monument in 1918 after lands on either side of 1909 reservation were added. Presidential Proclamation No. 1435, 40 Stat. 1760.

According to its enabling legislation, Zion was reserved for the purpose of protecting "unusual archaeologic, geologic, and geographic" resources. The National Park Service will likely argue during the quantification process that protection of these resources requires access to the full flow of the Virgin as it passes through the park. Falvey interview.

[286] Interview with Scott Loveless, Office of the Solicitor, United States Department of the Interior, December 9, 1992.

some of the NRA's best opportunities for fishing.[287] The Lake Mead stretch of the Virgin may also contain some woundfin habitat, as well as a number of Category II plants.[288]

Lake Mead's priority date is October 8, 1964.[289] Its enabling act, as can be expected, explicitly directs that management of the area should focus on recreational resources, as well as on the "scenic, historic, scientific, and other important features of the area."[290]

Though the Virgin River basin is rich in areas possibly deserving wilderness status, only the Beaver Dam Mountains and the Pine Valley wilderness areas have thus far been designated. Several Wilderness Study Areas (WSA), including Parunuweap Canyon, LaVerkin Creek, and Virgin River North Fork, are included in proposals for Utah wilderness.[291] Though the Tarr Opinion temporarily forecloses the potential for reserved rights in Beaver Dam Mountains, the BLM has until only recently been filing extensions to stave off a deadline for asserting water rights on the Utah side of the wilderness. BLM's decision to end its policy of filing for extensions leaves the water future of the area uncertain.

Often overlooked is the fact that the Shivwits Indian Band, which occupies about 29,000 acres of land in the Virgin basin, also holds reserved water rights. Current depletion for the Shivwits is now approximately 200 acre-feet yearly.[292] However, that number could increase dramatically once the band's reserved rights claims are quantified.

The Resource Management Planning Process

Two protective approaches are available via the RMP process for river resource protection: Wild and Scenic River designation, and Area of Critical Environmental Concern

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[287] Interview with Bill Burke, Resource Management Specialist, Lake Mead National Recreation Area, January 4, 1993.

[288] Burke interview.

[289] 16 U.S.C. §460n et seq. October 8, 1964.

[290] 16 U.S.C §460(n).

[291] See Figure 29. Compiled from Wilderness at the Edge.

[292] Utah State Water Plan, at 9-27.

designation. Unfortunately, the BLM and other management agencies have yet to make full use of the protective opportunities afforded by FLPMA, the planning process, and other pertinent legislation.

Wild and Scenic River Designation

The Wild and Scenic Rivers Act (WSRA)[293] is another method available to protect instream demands--defined in the WSRA as scenic, recreational, geological, biological, historical, and archeological "values."[294] Decisions regarding wild and scenic status are usually made as part of the RMP process. Nomination and eventual designation requires a two-step process. First, the planning entity develops a list of waterways eligible for potential listing. Eligibility criteria require only that a river segment be free-flowing, and that it possess at least one "outstandingly remarkable" example of the river-related values described above.[295]

Segments found eligible for designation are concurrently pre-classified as potential "wild," "scenic," or "recreational" stretches.[296] Eligible segments are also afforded interim protection, with the agency required to provide "adequate protection, subject to valid existing rights[;] until the eligibility determination is superseded, management activities and authorized uses shall not be allowed to adversely affect either eligibility or the tentative

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[293] 16 U.S.C. §1271 et seq.

[294] 16 U.S.C. §1271.

[295] United States Department of the Interior, Bureau of Land Management. Wild and Scenic Rivers: Policy and Program Direction for Identification, Evaluation, and Management [hereinafter Wild and Scenic Rivers Manual] (n/d) [at §.31A].

[296] "Wild" rivers are defined broadly as primitive rivers free of impoundments and shoreline development. "Scenic" stretches are to be largely undeveloped, though perhaps accessible by roads. "Recreational" rivers are readily accessible, and may include some shoreline development and/or impoundment. 16 U.S.C. §§1273(b)(1)-(b)(3).

classification...."[297] After classification begins a period of "suitability study," during which several additional river-related issues are considered:[298]

* Other characteristics that do/do not make the area a worthy addition to the Wild and Scenic River system;
* Current status of land ownership and use in the area, including private lands and other conflicts;
* Reasonably foreseeable uses for the land and/or values that could be enhanced, foreclosed, or curtailed if the river is added to the system;
* Public, State, local, or Federal interest in the possible designation of the river;
* Estimated costs of acquiring land and administering the area;
* Ability of the agency authority to manage the area as a Wild and Scenic River;
* Historical or existing rights that would be adversely affected.

At the time of final designation, which requires an act of Congress, the responsible federal agency will determine the amount of instream flow required to meet the values at the core of the designation. The federal government may then purchase water rights to meet that need.

Designated rivers are to be administered "in such a manner as to protect and enhance the values which caused it to be included in said system without, insofar as is consistent therewith, limiting other uses that do not substantially interfere with public use and enjoyment of these values."[299] Generally, rivers designated as "wild" are managed with an emphasis on protecting the segment's remarkable value(s) while providing river-related recreational opportunities. Management of "scenic" rivers provides for a wide range of uses--including agriculture, silviculture, and water management--as long as they are compatible with the river's values and do not adversely affect the river or its surrounding environment. Finally, water development projects such as impoundments or diversions could conceivably be constructed on "recreational" rivers as long as they do not adversely impact the river. Designation does not interfere with existing water rights, or with the majority of uses on private lands.[300]

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[297] Wild and Scenic Rivers Manual, at .32C.

[298] Wild and Scenic Rivers Manual, at §.33A.

[299] 16 U.S.C. §1281(a).

[300] Wild and Scenic Rivers Manual, §5 et seq.

Attempts to designate stretches of the Virgin River as part of the Wild and Scenic system have so far met with little success. The RMP process in the three basin states is unsettled at best, and is certainly uncoordinated: as mentioned above, the Strip District's plan is complete, Stateline's is only at the draft stage and the Dixie's is undergoing yet another rewrite. However, evidence from each RMP shows that some segments in the Virgin basin are indeed worthy of wild and scenic status.

Utah

The now-defunct Dixie RMP eligibility study initially classified three waterways as potentially "wild": Deep Creek, the North Fork of the Virgin near Zion National Park, and the segment of the mainstem Virgin that runs through the Utah portion of the Virgin River Gorge. These three were to receive interim protection under the RMP, pending a suitability review in concert with other land management agencies.[301] The RMP also identified another dozen or so free-flowing sections of the river, but decided not to classify them.[302]

However, in late May 1993, the Dixie Resource Area released the results of a second wild and scenic study.[303] Termed a "Planning Update," this action served to segment the wild and scenic study from the already long-delayed Dixie RMP, and opened that portion of the resource management planning process to yet another round of public comment.

The "Planning Update" notes that only 17 of the 63 waterways analyzed in the Dixie Resource Area are eligible for wild and scenic status.[304] In the process of eliminating the other 46, BLM appears to have deviated substantially from criteria outlined in the Wild and Scenic Rivers Act and in the BLM's Policy Manual. Most striking is that the Dixie Resource Area in many cases reached the question of *suitability*, rather than limiting its analysis to

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[301] Dixie RMP, at 114.

[302] Dixie RMP, at 196.

[303] United States Bureau of Land Management, Dixie Resource Area. A Planning Update (May 24, 1993).

[304] See Figure 30. Compiled from A Planning Update.

eligibility. Twenty waterways were deleted from the eligibility list due to BLM's determination that it did not hold jurisdiction over 40% of the shoreline and adjacent land on those particular waterways--despite the fact that the issue of land ownership status is to be addressed at the suitability stage.[305]

BLM deleted another 19 waterways under the notion that they are dry or otherwise not "free-flowing." While this consideration is indeed part of the eligibility determination, the Utah State BLM Office Manual employs several criteria regarding free-flowing rivers that are inconsistent with both the statute and the Bureau-wide Manual. For example, Utah BLM's assertion that dry washes are inherently ineligible is without legal basis, as is its finding that standing riparian areas are likewise automatically ineligible.

The Dixie's determinations regarding the lack of "outstandingly remarkable" values on some waterways may also be flawed, as there exist no field notes, photographs, or other documentation to support BLM allegations that rivers deemed ineligible for further study are indeed without significant attributes. It is expected that these concerns will be raised when the RMP is completed and opened for public comment in the fall of 1993. Pending completion of the RMP and another attempt at completing a lawful eligibility review, all watercourses in the Dixie Resource Area, including those entirely ignored in the May 1993 "Planning Update," should be designated as eligible for wild and scenic status, pre-classified, and afforded interim protection.

Arizona

Of the three basin states, Arizona is clearly the most progressive regarding wild and scenic status for the Virgin. After the Arizona segment was dropped from the 1982 National Rivers Inventory (NRI), citizen activists in Arizona were able to convince BLM, during the Arizona Strip's RMP process, to again study the river for designation.[306]

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[305] Additionally, it should be noted that the Wild and Scenic Rivers Act is silent on the issue of lands jurisdiction as it relates to W&SR status. Both the National Park Service and the Forest Service are without a "40% Rule" like the one enunciated by BLM.

[306] Strip RMP, at A-62.

With the completion of the RMP came the decision to list the entire length of the Virgin in Arizona as eligible for wild and scenic status.[307] The plan divides the river into four segments. Segment 1, running for three miles through the Beaver Dam Mountains Wilderness Area, is classified as potentially wild. Segment 2, a nine-mile stretch from Interstate 15 to the Virgin River campground, is potentially scenic. Section 3, a seven-mile segment between the campground and the mouth of the Virgin River Gorge, and Section 4, the fifteen miles from the Gorge mouth to the Arizona/Nevada state line, are mentioned for possible recreational status. All four segments will be protected under interim management until a decision regarding suitability is made.

The Strip RMP also noted that the suitability decision would be made within the five years provided for by the WSRA, and that it would be made as part of a coordinated, Virgin-wide study to include both the Utah and Nevada segments.[308] That plan was recently jettisoned, however, after Congressional representatives, allegedly responding to pressure from Arizona environmentalists, decided to concentrate on designating rivers in Arizona only, asking that the Strip BLM accelerate its ongoing suitability study of the Virgin and limit it to the Arizona segment.[309] Thus, the future of any designations in Utah and Nevada remains uncertain at best.

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[307] Strip RMP, at II-6.

[308] Strip RMP, Appendix 18.

[309] Interview with Matt Safford, Arizona Strip BLM, February 23, 1993. Arizona has been given a deadline of December 1994 to complete a state-wide wild and scenic plan. Scoping for the environmental analysis component of the process began in early April 1993.

The Arizona Rivers Coalition is proposing that some 1700 miles of the state's rivers be designated Wild and Scenic. Included in that proposal is 35 miles of the Virgin, running from the Utah/Arizona state line to the Arizona/Nevada state line. Arizona Rivers Coalition. Arizona Rivers: Lifeblood of the Desert (March 1991) [at 151].

Nevada

The Stateline Resource Area office of the BLM has divided the Nevada stretch of the Virgin River into three segments: Segment 1 includes about 14 river miles from the Arizona/Nevada state line to Riverside, NV; Segment 2 runs from Riverside Bridge to the Overton State Wildlife Management Area, a distance of about ten river miles; and Segment 3 begins at Overton and ends at the border of Lake Mead NRA. All three areas are deemed eligible for wild and scenic designation, primarily due to the Virgin's provision of wildlife habitat, as well as opportunities for scientific study and recreation. The Stateline RMP suggests a classification of "recreational" for all three segments. However, a decision regarding suitability of the Virgin for designation was not reached in the RMP.[310]

Areas of Critical Environmental Concern

Another approach (albeit a fairly toothless one, given its limitations as an administrative designation) available for the protection of resources dependent on instream flows is Area of Critical Environmental Concern (ACEC) designation. Resource Management Plans in various stages of completion in Utah, Arizona, and Nevada contemplate the designation of several ACECs in the Virgin River basin. The Dixie RMP suggested such designations to protect threatened and endangered aquatic species on the Lower Virgin River.[311] The RMP also identified instream flow requirements for T&E fish on the Virgin River, the Santa Clara River, the West and East Forks of Beaver Dam Wash, LaVerkin Creek, North Creek, Red Bluff, Ash Creek and Deep Creek.[312]

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[310] Stateline RMP, at H-3.

The Stateline BLM defers the final decision on the Virgin's suitability for wild and scenic status, noting that "[t]he only action required at this time is a study of the Virgin River for potential designation as a 'Recreational River'" [Stateline RMP, at 4-54].

[311] Dixie RMP, at 127.

[312] ACECs proposals are outlined in the Dixie RMP at 130-145. Note that not all of these are water- or T&E-related, and that they carry varying management prescriptions.

The Arizona Strip's RMP deems the Virgin River corridor east of the Beaver Dam Mountains wilderness eligible for ACEC status in order to protect riparian values, woundfin minnow habitat, and the scenic resources of the Virgin River Gorge.[313] Potential ACECs in Nevada focus on the protection of Virgin River fish habitat, as well as other scenic, cultural, and geological values.[314] A conservationists' proposal for ACECs in the Virgin River basin is found at Figure 31.[315]

Endangered Species Protection

The Endangered Species Act (ESA)[316] outlines a mechanism for identifying, listing, and protecting wildlife species facing various levels of threats to their continued existence. The ESA defines "Endangered" species as those "in danger of extinction throughout all or a significant portion of its range,"[317] while "threatened" species are those "likely to become endangered within the foreseeable future throughout all or a significant part of its range."[318] An additional eight categories reference species proposed for listing, under study for potential listing, thought to be extinct, or removed from consideration for listing. Over six hundred species currently receive some form of protection under ESA.

Of particular importance are the jeopardy provisions of ESA's Section 7. Section 7 requires assurance that all actions authorized, funded, or implemented by the federal agencies "will not jeopardize" populations of threatened or endangered species and/or will not destroy or adversely affect T&E habitat.[319] In those cases where the potential for harm to a species

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[313] Strip RMP, at A-20.

[314] Stateline RMP, Map 2-20.

[315] Also see Map 1, which denotes some potential ACECs in the Virgin River basin. These potential ACECs are keyed to the list in Figure 31.

[316] 16 U.S.C. §§1531-43 (1982).

[317] 16 U.S.C. §1532(6).

[318] 16 U.S.C. §1532(20).

[319] 16 U.S.C. §1536(a)(2).

exists, the pertinent federal agency must seek a biological opinion from FWS. That opinion will either permit the project to move forward, force it to be dropped, or allow it to proceed with appropriate changes and mitigation measures in place.[320]

Also critical are ESA Section 9, which outlaws the "taking" of threatened or endangered species,[321] and Section 10, which describes the statute's exemption for "incidental" takes.[322] Regarding the latter, ESA allows in some cases a particular level of take for certain projects, provided that the project minimizes adverse impacts and does not reduce the likelihood of a particular species' continued survival. Projects meeting this mandate are issued a take permit and allowed to continue as long as its requirements are met.[323] Finally, Section 3 requires that critical habitat be designated concurrently with the listing of a species as threatened or endangered.[324]

The ESA is central to the protection of native fish on the Virgin River. Unfortunately, a number of factors--including understaffing, underfunding, the political nature of many ESA-related decisions--have combined to delay or, in many cases, block outright the implementation

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[320] Thousands of consultations have been requested of FWS over the last five years, with the vast majority of those (89%) resolved informally and, therefore, without the preparation of a biological opinion (BO). In those cases where FWS elected to prepare a BO, over 90% determined that the proposed federal action would not place a species in jeopardy. Overall, the 2050 consultations undertaken since 1987 resulted in only 181 jeopardy opinions--about 9%. Of those few instances where a jeopardy opinion was rendered, almost 90 percent of the BOs provided alternatives that allowed the project to proceed. United States General Accounting Office. Endangered Species Act: Types and Numbers of Implementing Actions (May 1992) [at 30].

[321] 16 U.S.C. §1538(a)(1)(B). Note that the term "take" is defined in the statute as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect." 16 U.S.C. §1532(19).

[322] 16 U.S.C. §1539(a)(1)(B).

[323] 16 U.S.C. §(a)(2)(B). Most Section 10 permits are issued as a result of private, rather than federally-funded, activities. For example, consultation under Section 10 should be initiated prior to each irrigation year in order to determine if the operation of agricultural canals and other infrastructure could result in "incidental" takes of native fish.

[324] 16 U.S.C. §1533(a)(3).

of its guidelines. For example, an initial decision--called a 90-day notice--regarding the proposal to list the Virgin River spinedace was delayed by five months, and was only released in early March 1993.[325] The recently-rejected HCP, which supposedly outlines a management program for the numerous special status species in Washington County, Utah, actually addresses the situation of only the desert tortoise--and at that it does so inadequately by proposing a plan that would actually allow significant residential construction in tortoise habitat. Furthermore, protections and management prescriptions for the remaining T&E species in the county, including woundfin minnow and Virgin River chub, are essentially absent.[326]

Critical habitat designation for the Virgin River chub has likewise been delayed by more than five years, despite threats of litigation from environmental organizations.[327] And, even if habitat is eventually designated, there is concern amongst some fisheries biologists that the anticipated critical habitat designation will not be adequate for the purpose of ensuring the survival of the Virgin's native fish.[328]

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[325] ESA provides that a final listing decision must be made within a year. 16 U.S.C. §1533(b)(3)(B). It also requires "to the maximum extent practicable" that an initial finding be made within ninety days of the receipt of a listing petition to determine if the information presented warrants eventual listing. 16 U.S.C. §1533(b)(3)(A).

The American Fisheries Society filed the spinedace petition on July 13, 1992. A FWS finding that listing may be warranted was indeed issued, though not until March 4, 1993--about eight months after the petition was first received at FWS.

[326] HCP, at 55.

[327] Letter from Mark Hughes, Sierra Club Legal Defense Fund, to Manuel Lujan, then-Secretary of the Interior, and to John Turner, then-Fish and Wildlife Service Director, February 7, 1992. Litigation has not yet been initiated on this issue.

[328] W.L. Minckley of Arizona State University expects that critical habitat in Utah will be limited to the range from Pah Tempe Springs to Washington Fields, a designation he maintains is "inadequate" because it both affords no protection from impacts upstream and sacrifices potential habitat downstream to red shiner and other exotic populations. Minckley interview.

There is also no consensus among researchers that the anticipated designation of "parallel" critical habitats for woundfin and the Virgin River chub will be successful.

(continued...)

There also remains the possibility that additional species now found along or within the Virgin River could be added to the threatened and endangered list. The so-called "Moapa" subspecies of the Virgin River chub is one potential candidate. Dr. W.L. Minckley, in a letter to FWS, notes that the Fish Recovery Plan for the Virgin would be well-served by including the Moapa population as part of the recovery effort.[329] A variety of other reptiles and herpetiles may be threatened, though the general lack of research on species in this region makes trends in their populations and habitats difficult to discern.[330]

In addition to the FWS activity aimed toward adding to the T&E list, other federal agencies have demonstrated an interest in protecting sensitive species. The various BLM offices in the basin have, through the resource management planning process, included such protection as one of their resource management goals. The Shivwits implementation plan, for example, expects to "[i]mprove the habitat and population levels of woundfin minnow and Virgin River chub to the point these species no longer need listing," while other RMPs outline similar objectives.[331] Of course, wildlife protections outlined in individual RMPs are a great deal less binding than are the protections afforded by the ESA, and in fact are superceded by the statute;

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[328](...continued)
Minckley does not accept the notion that such a decision will serve both species adequately. University of Nevada-Las Vegas researcher James Deacon, also an expert on Virgin River native fishes, is on the other hand confident that a parallel habitat will be suitable. Interview with James E. Deacon, Professor of Biology, University of Nevada at Las Vegas, Las Vegas, NV, February 23, 1993.

[329] Minckley, W.L. Comments on Native Fish Recovery Plan (n/d) [at 2].

[330] Ross interview. Ross also noted that Gila monsters and leopard frogs are in particular danger of disappearing before necessary research is completed.

[331] Shivwits Implementation Plan, at 21. The Dixie RMP proposes to "protect and conserve all Federal listed Threatened and Endangered and candidate plant and animal species and their habitats, as provided by law, and to increase such populations where opportunities are present." Dixie RMP, at 127. The Stateline RMP, while focusing on desert tortoise and bighorn protection, is relatively silent regarding native fish protection, though it does consider development of a habitat management plan for woundfin recovery. Stateline RMP, at 2-8. Otherwise, the RMP simply indicates a willingness to obey state and federal laws regarding sensitive species protection. Stateline RMP, at 3-30. Of course, these are merely management ideals and are not fully enforceable.

yet, at the same time, RMP objectives do indicate a general management direction that can ideally drive decisionmaking.

Finally, interdisciplinary teams, like the Virgin River Fishes Recovery Team described above, can play an important role in devising policies aimed at not only protecting but also enhancing the population and habitat of sensitive species. The Recovery Plan currently under public review and revision perhaps serves as an adequate basis for describing future research needs and goals. However, actual on-the-ground change is, unfortunately, given scant attention. Changes that appear unavoidable--limiting dam and diversion construction and stream channel modification, requiring water conservation in both the M&I and agricultural sectors, improving water quality, requiring compliance with Biological Opinions, asserting reserved water rights and instream flow rights, and so on, receive no, or only the most vague, attention. Without demanding such changes, the Recovery Plan will not stave off the demise of native fish in the Virgin River basin.

Putting the Approaches to Work

The federal statutes available for protecting the Virgin River's resources can, if enforced, significantly improve the current state of river management. Unfortunately, consistent enforcement has always been lacking and, as a result, the health of the river and its resources has been in steady decline. In order to reverse that decline, the following steps should be taken:

1. The Army Corps of Engineers should follow the advice of the U.S. Fish and Wildlife Service and end its practice of issuing "after-the-fact" Section 404 permits, especially in current or potential critical wildlife habitat. Anyone found to have initiated construction on the Virgin or its tributaries without the required permit will be charged with violating the Clean Water Act.

2. The National Park Service and the Bureau of Indian Affairs should continue their work toward securing federal reserved water rights for all federal reservations. Any claim under the reserved rights doctrine should be for the optimal amount of flow necessary to meet the needs of each particular reservation. Also, the Bureau of Land Management should anticipate reversal of the Tarr Opinion and begin developing a strategy to claim reserved rights in wilderness areas.

3. All three BLM Resource Areas in the Virgin River basin should make the designation of wild and scenic rivers a priority. More specifically, the Dixie

Resource Area should withdraw its flawed "Planning Update" and instead designate all waterways in the Resource Area as eligible for wild and scenic status--this would include, of course, interim protection for each waterway until suitability decisions are made.

The completion of the RMP process will also bring about final decisions regarding ACEC designation. The Southern Utah Wilderness Alliance recommends that the areas listed in Figure 31 be granted ACEC status.

4. The Virgin's native fish species are perhaps its most threatened resource. Therefore, SUWA recommends that all historical, current, and potential native fish habitat be designated "critical habitat" under the ESA. Listing of the Virgin River spinedace as "endangered" is also urged, as is an increased research focus on the other river-dependent species in the Virgin River basin. Finally, the operation of all existing structures on the river, including Quail Creek and other reservoirs, and also all diversions and irrigation infrastructures, be reviewed in regards to their impacts on native fish populations. Any operations found in violation of the ESA would then be required to either come into compliance or face dismantling.

5. The federal agencies exercising jurisdiction in the Virgin River should develop and implement a Memorandum of Understanding stating that the primary goal of Virgin River management will be the protection of the river and its dependent resources.

State Instream Flow Laws

As noted above, recognition is growing regarding the importance of protecting river health--whether it be recognized in the need to preserve riparian and wetland vitality, special status wildlife, or recreational and aesthetic values. Many of these demands can be met simply by keeping water in the river; that is, by guaranteeing through the acquisition of instream flow rights that an adequate supply of water will be available to meet instream demands.

The economic value of instream flows is also significant. Fisheries, not to mention hunting and other forms of water-based recreation, often contribute substantially to local economies, especially in the urbanizing areas of the West.[332] Instream flows can also serve

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[332] As discussed above, the comparative value for recreation water is at least as high, if not higher than, say, irrigation water. Also, skyrocketing visitation numbers at Zion (continued...)

groundwater recharge purposes, enhance water quality, and reduce water treatment costs due to improved dilution rates.[333]

Despite obvious advantages, statutory approaches to instream flow protection have been slow to appear. Those that did appear were often inadequate. For example, the concept of "minimum flow" protection was once advanced for fish protection purposes. However, these quantities failed to guarantee enough water to meet the needs of riparian vegetation and other instream resources. Loss of streamside systems in turn impacted the very populations supposedly protected. The concept has since been expanded to denote the protection of all aquatic resources in a particular area. Also, the concept requires expansion to ensure the protection of the random flow fluctuations and flood events critical to natural instream and streamside processes.

Protection of instream flows can be effected in several ways. Most common is the purchase of senior water rights by some entity--a public agency such as the BLM or a state water bureaucracy, for instance, or an advocacy organization like the Nature Conservancy. Invocation of the public trust doctrine, while it has met with some success in protecting instream flows, is not actively implemented in the Virgin basin states.[334]

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[332](...continued)
National Park and at the headwaters of the Virgin River itself illustrate the positive impact that instream flow protection can have on local economies. Visitors for the first ten months of 1992 numbered almost 2.5 million, with a total of 2,687,000 visitors for 1992. According to Falvey, "In the last 10 years visitation has almost doubled. The 1992 count was a staggering 93% increase from 1983." "Outdoor Notebook." Salt Lake City Tribune (February 15, 1993).

Zion is now in the process of asserting water rights that could work toward protecting the park from upstream water development that threatens several world-class hiking trails in the park.

[333] Checchio, Elizabeth and Bonnie C. Colby. "Refining the Water Transfer Process: Innovations for Western States." In Shupe, Steven J. (ed.). Water Marketing 1988: The Move to Innovation. University of Denver College of Law: Denver (1988) [at 3-13].

[334] In Utah, for example, an application for appropriation can be denied by the State Engineer if it is determined that the appropriation would "unreasonably affect public (continued...)

Generally, though, most successful attempts to acquire instream rights have benefitted from a relatively recent evolution in state water law--the inclusion of provisions for asserting and securing instream flow rights. Utah now recognizes, though to a somewhat limited extent, instream flow protection as a beneficial use. This recognition, however, applies only to those instream rights transferred from consumptive uses; Utah law does not allow the appropriation of unappropriated water for instream uses.[335] The opportunity to claim instream flows is available to the Utah Division of Wildlife Resources in order to protect fish propagation and/or preserve natural stream environments, and is dependent upon legislative approval.[336]

In Arizona, any person, or the state itself,[337] can appropriate water and choose to leave it instream for recreation or wildlife purposes.[338] Nevada, on the other hand, reaches a decision on the viability of instream flow rights via a public trust clause in its state water statutes.[339]

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[334](...continued)
recreation or the natural stream environment, or will prove detrimental to the public welfare..." [U.C.A. §73-3-8(1).

Arizona water law notes that "...when the [appropriation] application or the proposed use...is against the interests and welfare of the public, the application shall be rejected" [A.R.S. §45-153(A)]. There is no mention of public welfare concerns in Nevada's water-related statutes.

[335] U.C.A. §73-3-3(11)(g)(i).

[336] U.C.A §§73-3-3(11)(a) and (b). This opportunity may also be utilized by the Division of Parks and Recreation for public recreation purposes.

During meetings of the Utah state legislative committee working to develop the language for the instream flow bill, one legislator remarked that instream regulation was "something they did in Russia." "That's What 'They' Did in Russia!?" Southern Utah Wilderness Alliance (Winter 1991/1992).

[337] A.R.S. §45-152(A).

[338] A.R.S. §45-152(B)(6).

[339] N.R.S. §§533.035.4 and 533.030(2).

Though the pursuit of instream flow rights via state systems has met with some limited success, a number of problems remain to be solved. By far the greatest concerns center around the most fundamental of issues, including who may acquire an instream right, how that right is quantified and at what priority date, and how it will interact with other rights.[340] Others note that since instream flow rights are both year-round and are situated along a stretch of river, rather than a emanating from single diversion point, they can be potentially constraining on water development proposals.[341] With these basic questions still unanswered, even more elusive issues concerning impacts on hydrologically-related groundwater, or whether instream rights can be asserted on ephemeral streams, have yet to receive attention.

As mentioned above, the BLM in each of the three basin states is directed to acquire, through the appropriate state process, some measure of instream rights along the Virgin.[342] Particularly exemplary is the Strip District's decision to file six applications--a total of almost 170,000 acre-feet--of instream rights on the Virgin River for the purposes of recreation, wildlife, livestock, and overall river protection.[343] A result of the Strip's assertion was the initiation of a BLM-sponsored, tri-state study with Nevada and Utah to "inventory and analyze stream dependent resources to determine minimum flows necessary to assure their continued

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[340] Warskow, William L. "Instream Flow: Rights and Priorities--A Rational Approach." In American Water Resources Association Arizona Section. Proceedings of the Symposium on Instream Flow: Rights and Priorities. Tucson, Arizona (October 30, 1987) [at 103].

[341] Colby Saliba, Bonnie. "Instream Flows--Economic Values and Policy Alternatives." In American Water Resources Association Arizona Section. Proceedings of the Symposium on Instream Flow: Rights and Priorities. Tucson, Arizona (October 30, 1987) [at 69].

[342] United States Department of the Interior, Bureau of Land Management, Arizona State Office. Project Plan: Virgin River Instream Flow Assessment [hereinafter Project Plan] (May 1992) [at 4], citing Bureau of Land Management Manual §7250.

[343] Arizona Department of Water Resources. Notice of Application to Appropriate Public Water. October 20, 1989 (reissued September 21, 1992). The proposed volume is 166,566 acre-feet annually.

existence."[344] BLM expects that this study will conclude in a report detailing the monthly flows needed in Arizona to meet riverine values; additionally, each state will use the study to develop flow maintenance strategies to ensure that the Virgin delivers the water necessary to protect riverine values.

Project research already completed includes a June 1992 inventory of special status fish, which sampled woundfin as far downstream as Nevada's Halfway Wash. Three months later, researchers flew the length of the Virgin and photographed it with infrared cameras to assess habitat location and condition. Data collection on stream substrates, continued research on native fish populations, and surveys of riparian vegetation were planned for Spring 1993.[345]

The Arizona Strip BLM has also filed an application on the Beaver Dam Wash. The 1,176 annual acre-feet will likewise be used to ensure a "continuous minimum instream flow to

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[344] Project Plan, at 1.

The project will assess 120 river miles in three segments: the North Virgin segment, from North Creek at Zion National Park to its confluence with the Virgin River, and then downstream to Washington Fields diversion; the Gorge Segment, from Atkinville through the Gorge to Lower Narrows Springs; and the Overton Segment from Lower Narrows Springs to the Overton State Wildlife Management Area.

According to Project Coordinator Ron Hooper, the study will utilize a "value approach" to review all resources supported by instream flows, and will emphasize threatened and endangered wildlife, riparian areas, recreation and aesthetic opportunities, water quality, and cultural resources. Interview with Ron Hooper, BLM Instream Flow Assessment Project Leader, Phoenix, AZ, January 12, 1993.

The study will not include some regions near St. George and Zion National Park, due to the abundance of private lands in the area. Additionally, all tributaries, except for Virgin North Fork, LaVerkin Creek, and Deep Creek, will be left out of the study. Project Plan, at 5-11.

Note that there is no stated intent to study maximum or optimum flows to ensure river resources; the focus will be upon minimum flows only.

[345] Hooper interview.

meet the needs of endangered and threatened wildlife, including fish."[346] The Strip BLM's study on Beaver Dam Wash, which began in February 1990, will also investigate groundwater and surface water interactions in the region, with an eye toward proposals to transport groundwater out of the region for M&I use in Utah and Nevada.[347]

Local Ordinances

The role to be played by decisionmakers at the county and city levels in affording protection to instream uses can also be critical. Local and county ordinances addressing water use practices can be successful, especially those implementing, or providing incentive for, community-wide water conservation measures. Ordinances requiring the use of water-saving appliances in new homes and the retrofitting of existing homes are addressed in Chapter VI, as are strategies for reducing the amount of water consumed in residential-area lawns and gardens. Other local-level approaches could include the manipulation of hookup and building permit fees so that low-volume or efficient users are charged a lower rate to bring a new building into the local water distribution system.

The same strategies can be applied to the industrial sector. At least one observer notes the possibility of requiring the implementation of water-saving technologies by inefficient users, much as the Clean Air Act requires air polluters to adopt Best Available Control Technologies.[348]

Water-saving ordinances have the potential to limit continued inefficient consumption and to work toward eliminating additional wasteful users. Adoption of both paths could in turn

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[346] Arizona Department of Water Resources. Notice of Application to Appropriate Public Water. October 15, 1992.

[347] Letter from George W. Cropper, Shivwits BLM Area Manager, April 29, 1993.

[348] Tarlock, A. Dan. "The Changing Meaning of Water Conservation in the West." 66 Nebraska Law Review 145 (1987) [at 169]. Despite forwarding the notion, Tarlock seems generally opposed to the BACT model for water conservation, primarily because of the economic impacts it could have on smaller industries. However, Tarlock also speaks positively of Arizona legislation requiring industrial users to implement the latest available conservation technology, so long as it is consistent with a reasonable economic return [at 170].

significantly reduce the amount of water removed from streams and rivers to service M&I sector needs. Some water researchers have noted that "[s]avings of 20 percent or more are feasible by changing patterns of water use and developing plumbing codes that require installation of water-saving devices in new construction of living and working quarters."[349] The actual level of savings remains to be seen, however, as the communities of the Virgin River basin have thus far failed to act on their powers to implement conservation measures.

Local governments can also exert control over growth. One approach involves the setting of limits on services and other infrastructure. For example, a community could set a maximum number of hookups to the public sewer system; requests for hookups beyond that number would be refused. A "pay-as-you-go" approach should also be instituted. This would require that the costs of new development (e.g., costs to provide services to new housing, costs of increased police protection, etc.) would be measured against the econimic benefits of new development (in the form of additional tax revenues). Development proposals found to cost more than they yield would be prohibited.

Ordinances requiring greenspace, such as parks and walkways, in urban settings is yet another approach; other methods for limiting housing densities, and thus overall populations, can involve the designation of "greenbelts" or other buffer zones around the periphery of towns. Boulder, Colorado is one of several communities that has successfully kept growth to a reasonable level by ensuring the protection of undeveloped areas within and near the city limits.

Each of these approaches can, in its own right, contribute significantly to the protection of instream resources. Unfortunately, they tend to be employed in "brushfire" situations; that is, each is applied on a situation-specific basis, thus leaving the protection of riverine values vulnerable to the misapplication, or non-application, of protective measures. What is needed, then, are some new strategies--specifically, some that will lead to a rethinking of how we manage water demand and supply and, in the long-run, of how we think about rivers and river management.

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[349] Viessman, Warren and Claire Welty. Water Management: Technology and Institutions. Harper & Row: New York (1985) [at 23].

Chapter VI

Non-Structural Approaches to Water Management

> *[T]here is broad awareness in the West that the region has entered a different era in water, an era characterized by enhanced management, increased use of non-structural solutions to meet demand,...and cognizance of the growing value of water in non-consumptive, instream uses.*[350]

Structural approaches to water management, especially in the arid lands of the Virgin River basin, are becoming less and less rational every day. Just as importantly, they are increasingly less reflective of emerging public concerns, found throughout the region, that value instream uses and thus non-structural approaches. The potential damsites in the region possess disqualifying ecological, economic, and/or geological characteristics. Increased knowledge about instream flow demands, and about the consequences of not meeting those demands, also limits management plans that would divert water from the channels. Changes in the traditions of western water law reflect, to a limited extent, this growing recognition of instream uses. Finally, the federal government's exit from the water project funding business has slashed enthusiasm for large-scale water projects among those that previously depended on outside sources of fiscal support.

After shifting focus away from structural approaches, the task becomes one of defining non-structural means of managing water. These means will, as such, depart from the traditional dependence on diversions, dams, and reservoirs, and will focus instead on methods producing less adverse environmental and economic impact. The thinking behind these non-structural approaches also leaves behind the outmoded traditions that have controlled Virgin River management since the pioneers founded their first communities in the late 19th century. And, most importantly, as they will strive to better consider the link between water supplies and water

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[350] Volkman, John M., and Kai N. Lee. "Within the Hundredth Meridian: Western States and the River Basins in a Time of Transition." 59 Colorado Law Review 551 (1988). In Boundaries and Water: Allocation and Use of a Shared Resource. University of Colorado School of Law: Boulder, CO (1989) [at 551, citing Western Governors' Association Water Efficiency Working Group, Water Efficiency: Opportunities for Action 3 (1987)].

demands, they will move toward the goal of establishing some semblance of balance to management on the Virgin River.

Supply Management Approaches

While the failed policies of the past have tended to focus on controlling water supplies--usually, as mentioned throughout this report, by diverting and storing as much water as possible to be applied to an ever-growing demand in the M&I, agricultural, and instream sectors--some aspects of supply management may be useful as management methods.

Water Planning

Though the concept of water planning would seem to be an obvious approach to any water management regime, the fact remains that it has generally been practiced only within the traditional sense of the term. That is, "water planning" until relatively recently has taken the shape of water managers anticipating demand--often on the basis of highly-inflated growth projections--and then, essentially, working to divert and impound enough water to meet that demand. The water planning discussed below will instead focus on the development of water use practices that can ensure that water is available to consumptive uses without adverse impacts to instream resources.

Water planning will also depend upon the formulation of alternatives to meeting water demand. Where the term "alternatives" has until now been limited to potential damsite locations, successful water planning now requires the development of alternatives that make use of non-structural approaches:

> Comprehensive water planning requires states to consider how to manage existing supplies better, rather than simply to assume that future needs will be satisfied from newly developed sources.[351]

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[351] Getches, David H. "Water Planning in the West." 9 Journal of Energy Law and Policy 1 (1988) [at 22].

Viessman and Welty also address the need for alternatives in water planning: "Because of the great uncertainties surrounding forecasts, it is becoming common for planners to (continued...)

Professor David Getches, who has written extensively on the subject, describes several components that should be included in a modern water plan.[352] First and foremost, says Getches, water planning must be comprehensive, in that it consider the entire range of resources affected by water use decisions; to do so, water plans must be developed in conjunction with land use plans, wildlife protection and recovery plans, recreation proposals, reserved water rights, and so on. Unfortunately, the trend in the Virgin basin, if not in the West itself, has seen planning exist in a vacuum relative to other resources. The water plan must be a fluid document, and thus subject to continuous updating and revision, in order to help managers respond to unforeseen circumstances. The water plan must also be enforceable, with water planning entities provided the authority to disapprove proposals that do not reflect plan objectives or methods.

Conjunctive Use

Other supply management methods are based to no small extent on the need to intelligently analyze water demands. Trelease describes conjunctive use as "the name applied to several different practices and processes employed to coordinate the use of ground and surface waters in order to get the maximum economic benefits from both resources."[353] Since water

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[351](...continued)
explore several plausible alternative futures rather than to make single projections...Because it is difficult if not impossible to make single 'best' estimates...over periods of 100, 50, 20 or even 10 years, planners should not be bound by a particular projection or forecast. Instead, an alternative-futures approach of assessing future water requirements by investigating a range of possible outcomes should be used. In this way, an array of policy choices, tradeoffs, and options for water use can be evaluated." Viessman, Warren and Claire Welty, at 118. As has been discussed, options and tradeoffs are often obviated in the current planning atmosphere, given its obsessive focus on structural water development.

[352] See Getches (1988) and Getches, David H. "State Water Planning to Protect Public Needs." In Water as a Public Resource: Emerging Right and Obligations. University of Colorado Law School: Boulder, CO (1987).

[353] Trelease, Frank J. "Conjunctive Use of Groundwater and Surface Water." 27 Rocky Mountain Mineral Law Institute 1853 (1982) [at 1854].

moving through the hydrological cycle is linked (e.g., groundwater supplies often recharge surface streams, surface streams sometimes enter and replenish groundwater), water use in one location can often adversely impact opportunities for water use in another. Better coordination of existing water uses, therefore, can help ensure supplies adequate to meet demands.

Conjunctive use approaches come in several forms. One such approach involves underground storage of surface or flood waters.[354] Utah, among others, considers underground storage a beneficial use, as long as the location of the storage basin and the collection points are known.[355] While this may obviate the need for expensive and sometimes damaging artificial reservoirs, it may create as many problems as it solves--including questions regarding the rights of surface occupiers to the stored water and the complications inherent in trying to differentiate between waters "held" by various appropriators.

Trelease also addresses the possibility that water rights in interconnected water systems may be, for lack of a better term, "mobile." Under this scenario, an appropriator may be able to change a point of surface water diversion to another point employing a well that taps underground water feeding the surface water.[356] Allowing this sort of flexibility could lead to coordinated systems of diversion and storage, which in turn could limit conveyance losses, improve the efficiency of sprinkler systems, and improve water quality.[357]

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[354] Trelease, at 1880.

[355] U.C.A. §73-3-2.

[356] Trelease, at 1861. Professor Trelease cites one instance where a surface user was able to move his point of diversion from a surface ditch to a well that tapped the surface water's underground source. Furthermore, the user was able to retain his original seniority date, under the notion that he was appropriating the same water as before, but instead taking it from its underground source instead of from the surface.

[357] Trelease, at 1863.

Some states allow a surface diversion and an underground well to be used to supply the same water right; that is, a particular user can choose to pull water from either source depending on convenience, priority, costs, etc.

(continued...)

Coordinated surface water/groundwater systems could also lead to water exchange programs that would deliver a senior appropriator's water from a new source and thus free supplies for use by a junior appropriator.[358] For example, assume a senior appropriator is a surface water user and a junior a groundwater user. The junior could pump underground water into the senior's surface system and then take an allowed quantity for himself. This strategy--Trelease calls it "bypass pumping"--would again limit need for storage reservoirs, and would work toward guaranteeing the availability of surface flows for the senior user.

While conjunctive use approaches hold out some promise for improved supply management, there remains the concern that the complex web of water rights holdings in Western states--not to mention the complexity of interrelated hydrological systems--could make the development and implementation of a conjunctive use system very difficult.

Water Reclamation

For a variety of reasons, a great deal of water diverted for both M&I and agricultural uses never actually fulfills the need for which it is intended. Poor conveyance systems, evaporation losses, and the like[359] often result in a limited supply of appropriated water

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[357](...continued)
Trelease also suggests a potential approach requiring senior surface users (often inefficient ditch technologies) to use wells or other more efficient means to deliver their own water [at 1866]. In other words, a senior surface user normally requiring five acre-feet of underground water to produce his one acre-foot of surface water could be required to tap directly into groundwater for his one acre-foot and allow the surface water to remain instream. This approach is labeled "reasonableness of the means of diversion." Trelease, at 1873.

[358] Trelease states it much more elegantly: "If a surface flow of one acre-foot requires four acre-feet to support it, the pumper needing four acre-feet could pump out five, deliver one to the ditch, and keep the other four." Trelease, at 1864.

[359] A number of observers, including Clyde, have determined that evapotranspiration--the use of water by phreatrophytes, or streamside vegetation--also effects surface water loss: "Evapotranspiration directly from groundwater accounts for 16 percent of the groundwater discharge in the Central [Virgin] Basin." Clyde, at 35. Clyde suggests limiting evaportranspiration by artificially lowering water tables so that phreatrophytes (continued...)

reaching M&I users or agricultural crops. Management methods that would return these waters to the river could limit the adverse impacts of diverting water from streams to meet consumptive demands.

Treating and reusing wastewater and other effluent is one reclamation approach. Arizona is a leader in the strategy of using treated water, most of it from indoor uses, in place of groundwater pumping. In fact, reclaimed water is regarded as the only growing source in the state, as each individual contributes an average of 70 GPCD of wastewater to the system.[360] As much as 500,000 acre-feet of reclaimed water could be made available in Arizona by 2025.[361]

Incentives to increase the use of reclaimed water include allowing turf users utilizing 100% reclaimed water an extra one-half acre-foot over their usual allocations, and requiring new golf courses and other turf-intensive facilities to use at least 75% reclaimed water. Water pricing structures could also be revised to encourage use of reclaimed water to meet non-potable demands.

In the case of the golf courses in Littlefield, AZ, the reduction in consumption of non-reclaimed water would be subtantial. Over 1450 acre-feet of demand for golf course watering could immediately be eliminated, based on 1990 figures and the goal of using 75% reclaimed water. More importantly, over 6850 acre-feet of future demand would be offset by the same goal, assuming that Littlefield is successful in constructing the four to six new golf courses

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[359](...continued)
cannot reach groundwater.

Clyde also states that "[a]ny water so 'salvaged' would be water otherwise not beneficially used and no water rights would be affected." Clyde, at 35. The error of this statement is obvious, given what is known about the importance of streamside vegetation in providing wildlife habitat. Clyde does mention at one point that wetland habitat might be "changed" should water tables be lowered, but stops short of saying that it would be adversely changed.

[360] "Reclaimed Water, A Developing Resource to Help Meet State Water Needs." 2 Arroyo 1 (1988) [at 1].

[361] Reclaimed Water, at 2.

currently under plan.[362] As is the case with water planning and conjunctive use, water reclamation strategies present potential implementation problems. Questions regarding cost sharing protocols for distributing infrastructure costs, rights to reclaimed water, storage (especially during seasons of non-use in turf industries), and water quality protection have in many instances yet to be answered. And, much like the case with all supply management approaches, water reclamation does nothing to address the much larger and difficult issue of demand management.

Demand Management Approaches

The traditional--some would say quixotic--search for new water supplies to meet consistently growing demands is exhausting water-related resources in the Virgin River basin. Water managers are rapidly running out of options for further structural development, given the conflicting pressures exerted by special status species protection, by federal water rights assertions, by the demands of other instream users, and by dam safety and economics concerns. A large range of alternatives, however, exists in the field of water demand management. Researchers at the Rocky Mountain Institute list a number of advantages to be gained by attacking water management policy from the demand side, rather than from the supply side:

> Efficiency programs are generally faster, easier, and cheaper to bring on line than traditional supply-side programs. Since efficiency does not require the large, irreversible commitment of money that is required to build large storage and diversion projects, these programs reduce the financial risk of miscalculating demand far into the future.[363]

Since removing the traditional focus from water procurement and instead directing it toward discerning strategies to reduce water demand has the effect of limiting the need for expensive and, in some cases, destructive dams and reservoirs, it seems an appropriate approach for the already endangered resources of the Virgin River.

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[362] Current demand for golf course watering in Littlefield is 1944 acre-feet. Demand projections for the same use rise to 9144 acre-feet by 2040. Barrios presentation.

[363] Rocky Mountain Institute. Water Efficiency: A Resource for Utility Managers, Community Planners, and Other Decisionmakers. Snowmass, CO (1991) [at 8].

> *If any water taker shall waste water or allow it to be wasted by negligence, such as imperfect stops or valves, or leaky joints or pipes, or allowing tanks to leak or overflow, or wastefully run it through basins or other apparatus...he is guilty of an offense and upon conviction thereof shall be liable to a fine in any sum not exceeding $25, or to be imprisoned in the city jail not exceeding twenty-five days.*[364]

Most methods and technologies for reducing domestic water demand, though fairly simple and inexpensive, tend to yield immediate appreciable results. For the M&I sector, hardware-oriented approaches include the required use of low-flow appliances, installed either in new homes or when retrofitting older structures. Appropriate landscaping ordinances, such as xeriscaping requirements for homes and businesses, will limit household water demand in arid areas. Yet another option would be to require that water committed by new construction projects be saved elsewhere in the community by retrofitting paid for by the sponsor of the new construction. This would of course lead both to improved water efficiency in new construction and ongoing retrofitting in existing communities. The growth of the "retrofit business" in a community could in turn provide job opportunities and other economic advantages.[365]

Urban conservation success stories include Mountain View, California, where a local computer company underwrote the purchase of 5000 water conservation kits for the community. Mesa, Arizona reduced turf usage by up to 40% by offering rebates for landscape improvements.

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[364] 1909 St. George local water ordinance. In Making the Desert Bloom, at 10.

[365] "Water service companies" have already sprung up in several states, including Arizona, California, Florida, Colorado, and Virginia. These companies use private capital to purchase, install and maintain water-efficient technologies for users that tend to be water wasters--schools, apartments, and hotels, for example--and do not directly charge the consumer for hardware or labor.

The service companies then take between 50 and 80 percent of the money saved by the consumer via lower water bills, an incentive for both the consumer and the service company to save as much water as possible. "Water-Saving Entreprenuers Find a Gold Brick in the Toilet." U.S. Water News (April 19, 1993) [at 6].

Phoenix, Arizona, used a combination of public education, rate structure revisions, and hardware approaches to cut consumption by over five percent.[366]

Clark County, Nevada has adopted several ordinances and water conservation codes encompassing these, and other, approaches. In addition to landscaping guidelines and the inclusion of water-saving devices in building codes, Clark County bans new artificial lakes, restricts fountains and other decorative water devices and, perhaps most uniquely, forbids the adoption of housing covenants or codes that would restrict xeriscaping or require landscaping.

Considering population and water demand projections in St. George can put the potential savings of demand management into perspective. According to the Utah State Water Plan, population and water demand in St. George will increase as follows:[367]

Year	Population	Diverted (a/f)	Acre-Feet/Person
1990	28,502	12,898	.45
2000	43,400	19,639	.45
2010	60,507	27,381	.45
2020	73,373	33,203	.45

The .45 acre-foot diverted per person per year figure derived in the table above is equivalent to over 400 gallons of water diverted each day for each person in St. George--significantly more water than is diverted for use in Washington County's other communities or, for that matter, for use in most of the cities and towns of the American Southwest. Requiring that each St. George resident limit his or her current demand for M&I water by 10% (that is, to .405 acre-feet diverted annually) would, by 2020, limit diversions to about 29,700 acre-feet--a savings of approximately 3500 acre-feet. This volume of water is equivalent to the amount of

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[366] Dunford, Bill. "Tightening the Tap: What Other Communities Are Doing to Conserve Water." Utah Holiday (November 1992).

[367] Utah State Water Plan. Population figures are derived from page 4-1, water demand figures from page 11-8. Note that the "Acre-Feet/Person" column is in terms of diversions necessary to meet anticipated demand.

Also, note that, despite the UDWR's claims that its plan considers water conservation a viable option, it anticipates no reduction in St. George's per capita diversion rates between 1990 and 2020. The same is true for other communities in the Utah portion of the basin.

water diverted to meet the needs of 8600 people, based on a conservation-tempered demand level. Viewed another way, the 3500 acre-feet left undiverted is the amount of water that would be diverted by St. George over the span of nearly 39 days under the current demand level.

Equally important is the fact that water left undiverted in the channel would immediately benefit the myriad instream uses dependent on the waterway; while a certain amount of diverted water does re-enter the hydrologic system at some point, there is no assurance that the quantity and quality of that reintroduced water is suitable for the demands of instream resources.

A conservation plan centered upon only a ten percent reduction in water diversions by the year 2020 is modest at best. An approach that combines local mandates and financial incentives for demand reduction could produce savings in excess of those previously modeled. Further, even the conservative scheme outlined above becomes particularly important if St. George follows the growth path envisioned by some and one day reaches a population of 250,000.

Conservation in the Agricultural Sector

Of course, conservation opportunities are not limited to the M&I sector. The considerably more water-intensive agricultural sector must also limit its demand if increased efficiency in the domestic arena is to be of any benefit. Given the volume of water utilized for farming purposes, even single-digit increases in efficiency would make available significant amounts of water. Professor Getches places that opportunity into perspective:

> Agriculture accounts for 90% of the consumptive use of water in the West [citation omitted]. One writer found that if conservation measures were implemented that produced a seven percent reduction in agricultural use, the water available for other purposes would double [citation omitted].[368]

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[368] Getches (1988), at 3.

Others have noted that "...estimates of the water savings attainable through increasing efficiency in irrigation water management have been reported to range between 20 and 50 percent. The significance of this as a potential means of easing water supply problems in the western states is plain when one considers that irrigation is the largest single depletor of water in the United States." Viessman and Welty, at 22-23.

As is the case with the M&I sphere, agricultural conservation can be effected with a combination of technological approaches and policy revisions. Regarding the latter, it has been suggested that the legislative structure surrounding the uses of conserved water should be revised. The "use it or lose it" admonishment prevalent throughout traditional water law could, for instance, be amended to allow efficient users to sell conserved water. Likewise, conserved water could be deeded back to the state in order to provide for instream uses. The amendment of forfeiture statutes to exempt conserved water may also serve as an incentive to limit consumption.[369]

Simple improvements in farming and irrigation practices can work toward limiting the significant volumes of water usually lost to outmoded or inefficient methods. For example, a significant proportion of the water diverted for agricultural purposes, and lost to evaporation, unlined canals, leaky headgates, and other poorly-maintained irrigation structures, could be recovered via improvements financed, in some cases, by local urban users. Potential approaches to conserving agricultural water include lining permeable delivery and distribution canals with concrete or asphalt. Better field maintenance, such as reducing field slopes (and thus runoff) and constructing runoff impoundments will also limit waste.[370] Taken together, these improvements would yield the more efficient use of available water, and would thus limit the adverse impacts of diversions on instream resources.[371]

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[369] New Mexico Environmental Law Center. Living Within Our Means: A Water Management Policy for New Mexico in the 21st Century (1992) [at 22].

A recent Utah Supreme Court case, Steed v. New Escalante Irrigation Co. [to be published at 846 P.2d 1223, August 18, 1992] held that the defendant could not be required to continue use of outmoded irrigation practices that provided seepage and runoff flows for use by the plaintiff. In so holding, the Court reaffirmed its prior judgment that "the reappropriator of [wasted] water cannot require the first appropriator to continue to waste such water so that it will be available for use by the reappropriator." Hence, at least this Court seems to be signaling a desire to conserve irrigation water, even in the face of the "use it or lose it" doctrine.

[370] Also, according to Viessman and Welty, "Less than half the water delivered to farms is used by the crops, due to seepage through canal walls." Viessman and Welty, at 238.

[371] One study notes that "Agricultural water use was found to be so dominant in the [Virgin] basin that minimal adjustments in agricultural water use achieved by slight adjustments (continued...)

Estimating the amount of agricultural water potentially available via such improvements is particularly complex, as the exercise requires consideration of crop types, weather conditions, and many other variables. However, a relatively simple examination of the amount of water lost to inefficient irrigation delivery systems can reflect, though perhaps superficially, the amount of water realizable through such programs.

In Washington County, for example, sixteen irrigation companies surrender about 70% of their diversion volume, due to canal losses, runoff, and deep percolation. Overall, more than 59,500 acre-feet is wasted--19,500 in canal losses, and 40,000 through runoff and percolation--from the more than 85,000 acre-feet diverted.[372]

If a program of canal lining, field leveling, and so on were introduced with the goal of cutting these losses by a minimal ten percent, a significant volume of water could be retained. Limiting canal losses to 90% of the current rate would make 1950 acre-feet of water available for other uses--a volume equivalent to that required to meet the annual needs of 4330 people in water-wasting St. George. The same program goal could prevent 5955 acre-feet in runoff and percolation losses, equal to the demands of 13,230 St. George residents. A combination of canal and field improvements resulting in the need to divert ten percent less than the current volume could leave an additional 8515 acre-feet in the basin's waterways--the same amount of water used by almost 19,000 of St. George's current 30,000 or so residents.

Of course, it should be stressed that this water would likely not be of the quality necessary for many household uses; yet it would be available to support non-culinary uses (thus lessening the pressure on high-quality water supplies to meet those demands) and, more importantly, to support the needs of instream resources.

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[371](...continued)
in application efficiency could readily support all foreseeable needs for water for other uses." Nevada Center for Water Resources Research and Utah State University Water Research Laboratory. The Virgin River Basin Study: A Regional Approach to Multiobjective Planning for Water and Related Resources (1977) [at 4].

[372] Cooperative Study/Water Supply, at 26.

Recall that much of the wasted water eventually returns to the hydrologic system, though in uncertain quantity and quality.

Increasing the efficiency of agricultural water distribution can also serve as a path to demand management. For example, gypsum-block tensiometers have been found to be useful in helping farmers evenly distribute water and in limiting overwatering.[373] The tensiometer is simply a small block of gypsum containing twin electrodes. Since the gypsum blocks absorb and lose moisture at roughly the same rate as the surrounding soil, a battery-powered impedance meter can read the conductivity of the block and report soil moisture levels. This data in turn allows for more efficient irrigation scheduling. Combined with the use of drip or subsurface irrigation, agricultural operations can then reduce the amount of water lost to evaporation and other natural causes, as well as to poor agricultural methods.

Recent experiments aimed at limiting agricultural water demand in Kansas have combined the policy and technological approaches. The project, which was underwritten by $40 million from local banks, made funds available to upgrade irrigation efficiency. Measures employed include enhanced data collection regarding water use, cropping and acreage values, and rainfall data. Also, farmers replaced gravity irrigation systems with center pivot systems and installed drip/surge irrigation systems.

While the experiment is still in its earliest stages, sponsors expect groundwater use to decline by 15 percent and "little if any decreases in crop production and [the retention of] local economic productivity."[374] While the $40 million price tag may appear steep, it should be viewed in relation to the short-term capital and environmental costs of a new dam and reservoir, and to the long-term costs of addressing supply rather than demand.[375]

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[373] Rocky Mountain Institute, at 50.

[374] "Economic Incentive Being Provided to Improve Irrigation Efficiency." U.S. Water News (January 1993) [at 17].

[375] Agricultural conservation measures have also been implemented successfully in Southern California, where both the Metropolitan Water District and the Imperial Irrigation District have, among other improvements, lined canals, reconstructed leaky headgates, and automated distribution systems. As a result of the improvements, IID expects to reduce its diversions of Colorado River water by some 106,000 acre-feet per year. Rocky Mountain Institute, at 51.

If Virgin River communities are to ensure their access to water for the future, they must recognize the promise offered by increased efficiency in both the M&I and agricultural demand sectors. They must also realize, however, that water saved via conservation approaches cannot then be dedicated to other, new uses as they appear. That is, water conservation should not be viewed as a means to supply water to an ever-expanding demand base, as this defeats its very purpose. If that were to occur--if conserved water was simply directed to support continued out-of-control population growth, for example--then any "savings" are for naught. The purpose of conserving water is to limit wasteful demand, and to ensure that water remains instream and available to support the health of the Virgin and its related resources.

Water Pricing Reform

> *[W]ater is notoriously underpriced in nearly all applications: agricultural water has been heavily subsidized; municipal customers benefit from early capital investments that have long since been recovered; and all water users generally avoid paying for external effects on society or other individuals caused by the development of particular water sources.*[376]

The irrationality of typical water pricing structures has been discussed. Requiring water users to pay the true costs of meeting water demand would likely incite them to reduce consumption, probably by employing some of the conservation means outlined immediately above. Potential changes to traditional water pricing schemes include the implementation of marginal and block pricing plans.

The former sets rates based on the cost of producing the next unit volume of water; that is, the customer is in a sense paying the costs of the future water provision that will be required to make up for his present use. Marginal pricing removes, therefore, the consumer's ability to benefit from the low relative costs of previous water development. Since yesterday's water developments tend to be less expensive--whether because of federal funding availability, less complicated damsites, lower construction and interest costs, etc.--the present-day user benefits

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[376] Getches, David H. "Water Use Efficiency: The Value of Water in the West." 8 Public Land Law Review 1 (1987) [at 23].

from a subsidy of sorts by paying for those lower costs. Forcing the customer to acknowledge the future costs of obtaining water could drive demand down.

Another strategy is to implement block pricing, where the consumer pays a progressively higher rate as consumption increases. The Virgin River communities practice only the most primitive form of block pricing, as the number of block increments and the cost increase per increment are both too small to provide incentives for reducing demand.

Specific economic incentives can cut domestic demand and foster the growth of more efficient demand. Charging hookup fees in relation to the efficiency of new users, providing rebates to users either retrofitting or cutting consumption in some other way, and surcharging users failing to retrofit after some time period will reward the implementation of conservation measures.[377]

Finally, as Getches mentions above, consumers have so far been free of the obligation to pay for the externalities of water development, as environmental costs and opportunity costs are generally not factored into the economics of structural approaches to water management. Once these issues become part of the equation, it is likely that water prices will rise significantly. Until such costs are included in the decisionmaking process, it is up to water planners to require--through ordinances, reasonable rate structures, and so on--that water prices reflect the actual cost of obtaining water. Only then will consumers recognize the true impact of their demands, and only then will an incentive to reduce that demand be in place.

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[377] Approaches such as increased hookup fees cannot be employed in a vacuum, however. Simply raising the fee on new users provides no incentive for either retrofitting or for reducing consumption once the hookup fee has been paid.

This problem is exemplified by a recent decision by the City Council of Hurricane, Utah to add $300 to $800 to existing water hookup fees in order to cover the costs of new water development. The council's new policy does not include plans to revise water use costs, or to mandate conservation measures. The city's focus, then, is clearly on the development of new supplies, rather than on regulating and limiting demand--the "insatiable thirst" mindset is alive and well here. Summerill, Scott. "Hurricane May Boost Water Fees." The Daily Spectrum (January 22, 1993).

Supply/Demand Coordination

Since the days of the Wild West, access to water has been maintained via the prior appropriation doctrine, a system that inherently disregards the issues of actual supply and demand for one of traditional rights and uses. Prior appropriation, by its very nature, is generally incapable of addressing supply and demand conflicts--that is, it cannot ensure that supplies will come from sustainable sources, and it cannot ensure that water will reach those uses most in need of it and/or most capable of using it efficiently.

So far, this report's discussion of alternatives to the current practices of water planning has focused on (1) supply management and (2) demand management. There is a third fundamental approach available: a system that, unlike prior appropriation, considers questions of supply and demand concurrently, and works toward a more efficient matching of available supplies to reasonable demands.

Water markets allow water management to occur on the basis of meeting supply/demand and other economic trends.[378] That is, water markets allow willing buyers, whether they be a private individual or a state, to acquire supplies from willing sellers. Water sellers are in turn presented with the opportunity to profit from the sale of unneeded or unwanted water held through an appropriative right.

The most promising arena for water marketing is in the transfer of water from the agricultural sector to the M&I and instream sectors. As already detailed, agriculture tends to consume huge amounts of water in return for limited economic benefit. Since most agricultural water rights carry with them senior priority dates relative to M&I and instream uses--and since most streams in the West are already fully appropriated--it is difficult for those latter users to acquire water through the prior appropriation system. Further, the "use it or lose it" syndrome provides no incentive for high-volume users to, even voluntarily, direct unused water to other uses.

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[378] Rodgers, Ann Berkley. "The Limits of State Activity in the Interstate Water Market." 21 Land and Water Law Review 357 (1986) [at 358].

Water Market Types

Generally, water markets are characterized by the same components present in the marketing of any product: the water's value is distinct from that of neighboring land, diversion structures, and so on, and its selling price is agreed upon between a willing seller and willing buyer.[379] A myriad of arrangements between buyer and seller can be made to effect the transfer of the water to the former. Outright transfer of title, which would include the transfer of all legal claims and obligations connected to the water, is at one end of the spectrum. On the other end would be various option or contingency approaches, where the buyer is actually more a lessee. In many cases, this temporary arrangement provides water to the buyer only under certain conditions--say the onset of a drought, to meet a certain level of municipal growth, etc. These arrangements usually leave the marketed water available for continued use by the original consumer except until the agreed-upon conditions arise.

Somewhere in the middle of this spectrum are a number of other water marketing strategies. For example, a growing community may pay for improvements to a nearby irrigation system in exchange for access to conserved water.[380] Such an arrangement makes it possible to conserve water without actually retiring agricultural areas. Municipalities or states may also purchase outright or trade lands in order to take advantage of appurtency laws that would give them access to the water attached to that newly-obtained land.[381] In short, one of the following

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[379] See generally Saliba and Bush, which provides a basic overview of water marketing.

[380] Casper, Wyoming is one example of this strategy. In return for its offer to pay to rehabilitate the local irrigation district's canal system, Casper will eventually receive some 2000 acre-feet from the North Platte River. Rocky Mountain Institute, at 51.

[381] The practice of "water farming"--where a community purchases outlying, usually agricultural lands in order to gain its appurtency rights--is another form of the water market. See Woodard, Gary C. et al. The Water Transfer Process in Arizona: Analysis of Impacts and Legislative Options. Tempe: University of Arizona [hereinafter Impacts/Options] (n/d) [at 1].

will occur: a change in the ownership of the water right, in the type of water use, or in the location of the water use.[382]

The Promise And Problems Of Water Markets

An active water market can help provide what prior appropriation has historically failed to provide: an assurance that water is available to all users. Marketing approaches can, *if implemented correctly*, free water from what are often wasteful uses and provide a dependable supply for application to high-value purposes. Water markets can also often preclude the various costs of additional structural development.

The agricultural sector can also benefit from water market strategies. Farms with declining incomes can simply exercise an option to sell or otherwise dispose of individual water rights, often at considerable profit. Additionally, funds working their way into the agricultural sector via the water market can be used to improve irrigation efficiencies and crop varieties, and also to take advantage of new agricultural technologies.[383]

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[382] While by 1987, 75% of water transfers in Arizona were from agricultural uses to M&I uses [Woodard et al., at 3], this is not to say that all water marketing is done on this basis. Water transfers could conceivably be made within the agricultural sector, i.e., during drought years, users could work to transfer water supplies from low-value to high-value crops [Id.].

Such an approach could include a simple exchange of priority dates. A senior user could defer his right so that junior users will have access to water. This approach could be especially effective in the agricultural sector, as it would allow long-term, high-value crops (like orchards) to receive water while short-term, low-value crops like alfalfa could defer.

[383] Checchio and Colby, at 3-4.

See also Booker, James F. "Everybody Wins? An Economic Analysis of an Interstate Water Bank." University of Wyoming Water Resources Center: Laramie, WY (n/d). Booker notes that "If a market transaction results in a transfer from lower to higher valued use[,] there is every reason to believe that the underlying economic surplus will generate indirect benefits exceeding costs. If a large cash transfer to agricultural producers is made and enters the local economy, it is even possible that agricultural communities could indirectly benefit from water sales." Booker, at 2 (emphasis in original).

Water marketing will not succeed as a strategy, however, unless it ensures that the demands of instream resources are met. To be sure, a truly free and open water market will not necessarily reflect the interests of the instream user:

> [T]he market process provides buyers and sellers with little incentive to consider the impacts of transfers on other parties who may be affected--neighboring water users, basin of origin communities, and groups concerned about water quality, riparian environments and water-based recreation. The root of the problem is that markets deal very well with buyers' and sellers' own interests but provide no mechanism to account for broader third party and public interests.[384]

Conservation organizations, unfortunately, would seldom find themselves in a financial position to compete in the water market in order to ensure protection of instream values. Therefore, safeguards to do just that are necessary in any water marketing system. One such strategy would require a significant portion of all marketed water--say 50%, or even more--would be dedicated back to the river to address the demands of instream resources. The economic costs of this tax would be absorbed by the purchaser, whose anticipated water demands will compete with the needs of native fish and other values. The economic costs could, on the other hand, be shared by both buyers and sellers, thus requiring the latter to acknowledge the costs that their demands have historically extracted on other users.

Such a "transaction tax" would likely not prevent agricultural users from relenquishing their rights; nor would it cause developers or urbanizing regions to cancel their plans. What a properly conceived water market will do, however, is (1) free water that is currently "locked up" in the inefficient agricultural sector, and (2) ensure that a significant amount of otherwise unavailable water will be applied to instream uses.

Potential constraints on a viable water market include the agricultural sector's willingness to sell water rights, and the discretion of individual agricultural users to sell those rights. Regarding the former, the possibility indeed exists that users may simply choose not to sell their rights, even if the offered price is reasonable. Such resistance may arise from a desire to preserve the agricultural community, to preserve the tradition of the "family farm," or some other source. However, research underway in the Virgin River basin demonstrates that there

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[384] Woodard et al., at 75.

is little resistance among individual agricultural interests to the notion of a water market. A review of the preliminary data shows that 70% or more of the respondents recognize a clear willingness to sell among Virgin basin agricultural operations.[385] Likewise, water rights held as shares in private irrigation corporations can, in most cases, also be sold, leased, or otherwise transferred to other uses.[386]

Potential negative impacts on rural economies may also be of concern, however. So-called "third party" impacts--with the third party being all entities not directly participating in the selling and buying of marketed water--have come under a great deal of study from water market theorists.[387] A rural community in transition from water-user to water-provider may suffer the loss of its tax base or its bonding capacity, and may also face a reduction in revenue sharing opportunities. Also, indirect losses, such as that of jobs and income in local service industries, including farm-related services, could be severe as the agriculture sector is restructured. In the case of water transfers within Washington County, neither type of adverse impact would be expected. Any community-wide losses in the agricultural sector--either in terms of tax base or individual unemployment--will be more than offset by gains in the industrial and service sectors.

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[385] When asked if there appeared to be any apparent resistance among Virgin River basin agricultural interests to the concept of water marketing, researcher Lee Brown (author of a forthcoming study regarding options and obstacles to river management in the Virgin River and other basins) answered "Clearly not--unequivocally." Interview with Lee Brown, June 30, 1993.

[386] For example, the Articles of Incorporation for the St. George and Washington Canal Company, the largest irrigator in southwest Utah, were amended in 1974 to give the company the power to, among other things, "contract with the United States, the State of Utah acting through its Board of Water Resources, or any other public agency or agencies for the purchase, acquisition, or lease of water [or] water rights...." St. George and Washington Canal Company. Articles of Incorporation (July 17, 1900, amended February 19, 1974). The bylaws of Washington County's other large irrigators, including the Hurricane Canal Company and the Bench Lake Canal Company, also provide a great deal of discretion for transferring water rights to public agencies.

[387] Checchio and Colby, at 3-5. Note that third-party impacts are an expected part of the market process, as buyers and sellers tend to act in their best personal interest, rather than in the interest of third parties.

While far from a perfect solution, water marketing is one of many viable approaches to solving water management problems arising from reliance on the prior appropriation doctrine. If the marketing process includes strict stipulations to guarantee that water is provided to instream resources, it can serve as a method for moving water out of wasteful, inefficient uses and into more valuable applications. In the long-term, water markets could go far toward righting the inherent wrongs of the prior appropriation system--but only if its operation gives priority to the often-ignored needs of the river.

Chapter VII

A Conservationist Blueprint for Water Management Reform

The field of water management has for too long been dominated by those who look first to large-scale structural development as the answer to increasing demands for water. Much of this outlook arose in the earliest days of water planning in the West, where the federal government's role was primarily one of engineer and financier. That role has changed, to be sure, and the federal government now often finds itself playing the part of regulator, of protector of wildlife and free-flowing rivers. In short, it is now increasingly responsible to the instream resources that it once ignored in its days as dambuilder.

While the alternatives and reforms suggested above can improve the way water is utilized, there still remains the need for an entirely new form of Virgin River management that works across all jurisdictions and, at the same time, addresses the reality that water demands must be met on a sustainable and rational basis. Thus, "balanced management" begins with the institutional recognition that the Virgin is indeed a single, functioning entity, and proceeds with the notion that decisions affecting one component of that entity can affect, sometimes positively, sometimes adversely, the other components. Balanced management, then, requires that decisionmakers take into account the variety of issues at hand within the Virgin--its interstate nature, the reasonable needs of growing municipal populations, the demands and values of the region's agricultural sector, and the viability of river resources--before committing to a plan of action. The Virgin is a river of opportunity, in that it still survives to a degree where its resources can meet all reasonable demands upon it. For it to remain so capable, however, a plan for implementing the balanced management ideal must be provided. The plan begins with a rebuilding of the water management agencies.

Local Level Reform

Inherent in any water management reform effort is the need to reprogram the water management agencies themselves. Fundamental changes in the authority and operation of local organizations, such as WCWCD, are required. Of particular importance is the need for improved public accountability. Water conservancy bodies are generally influential and well-

funded. Many possess taxing and/or bonding authority, and many are granted power of eminent domain, as well as the authority to enter into contracts with corporations or public agencies.[388]

Given these wide-ranging powers, it would be assumed that public input is a critical component of a district's day-to-day operation. In Utah, however, these bodies are under no obligation to apprise the public of its current operation or its management plans; nor are they required to develop a mechanism that would ensure that public comment is considered when formulating those plans.[389] There is no permanent local forum where spending plans, dam proposals, water allocation decisions, and so on can be reviewed or alternatives proposed. The fact that Utah's conservancy district Boards are appointed, rather than elected, further illustrates the need to forge a link between the decisionmakers and those who will be affected, economically and otherwise, by the decisions made; as such, there is an obvious need to develop a mechanism for community-based water planning that includes representatives from wildlife and recreation interests, water conservation experts, alternative growth advocates, and so on.

Of course, local management reform must also include adoption of financial incentives and/or ordinance-level changes in the way water supplies and demands are managed. In many instances, revision of water rate structures, growth controls, landscaping guidelines, building permit requirements, and other water-use laws are within the purview of city and county governments. Such approaches can be made to work toward allocating water in a rational manner, and toward protecting riverine resources.

State Level Reform

As has been discussed, the Utah State Water Plan is, unfortunately, often at odds with the evident realities of Virgin River management. The plan's failure to acknowledge the critical role of federal agencies in water planning, for instance, or its failure to present or demand a

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[388] For example, see the general statutory language regarding Utah's water conservancy districts, beginning at U.C.A. §17A-2-1401. The specific powers of the Board are outlined at U.C.A §17A-2-1413.

[389] U.C.A §17A-2-1409(4)(a). Utah law requires only that the district hold an annual Board meeting and quarterly "special" meetings. Guidelines for the content, or even the purpose, of those meetings are not part of the statute.

rational approach to water conservation, calls into question the Utah Division of Water Resources' direction on water resource issues generally. Until UDWR jettisons the outmoded approaches to water management it depended upon in preparing the plan, it will only limit the opportunities available to recover and rehabilitate the Virgin.

Rather than proceed in its current role as water development cheerleader, the Division should be encouraged to lead all interests toward a water planning and management regime that (1) acknowledges and quantifies the externalities of continued water development on the Virgin, (2) develops and implements actual water plans, rather than documents that simply justify the *status quo*, (3) improves public participation at all levels of decisionmaking, and (4) focuses on water conservation and improved allocation, rather than on water supply development. The same changes, of course, are likely necessary at any state-level water development agency.

Reform efforts should not be limited to the methods of state water bureaucracies, however. State laws should be updated to ensure the viability of other river resources. Statutes allowing claims for instream flow rights should be liberalized in order to ensure that the process does not discourage organizations interested in securing flows for resource protection. Likewise, processes for reviewing and issuing stream alteration permits should be revised to ensure that resource protection, rather than applicant convenience, is the major criteria for decisionmaking.

If water marketing is to become a fully viable approach to water management, modifications to statutory law may be necessary. Those laws surrounding the water marketing process must, above all else, ensure that the demands of instream resources are met; a water marketing structure that does not account for the historic inattention to these demands is unacceptable. Also, while many agricultural interests will simply sell off their water shares in entirety, state water laws must be adapted to ensure that unneeded or conserved water can indeed be made available on the market.[390] Currently, Arizona forbids transfers that would take

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[390] State water law should also be amended to recognize more fully the values of instream flows for wildlife and other river values. For example, statutes allowing the marketing of conserved or reclaimed water could include a provision requiring that some percentage of that water be made available to meet instream demands.

(continued...)

conserved water away from the geographic area of the water right. Nevada allows transfers of conserved water only when it is uneconomical to use the water on the original site; the State Engineer has otherwise denied applications to market conserved water.[391]

Finally, state law references to the public trust component of water management must be broadened and enforced. Utah, for example, requires that the State Engineer reject any water rights application found to "prove detrimental to the public welfare."[392] Despite this charge, protection of public resources has more often than not been foregone due to development pressures and the traditions of prior appropriation. State efforts to invoke the public trust doctrine could begin, then, with the simple notion that water management decisions must acknowledge the need to protect public resources, such as native fish, water quality, and the like. Placing the burden of proof on the state to show that a new water right will not impact other instream demands is a necessary first step. While this interpretation of the public trust doctrine will not necessarily guarantee protection of instream values, it is a substantial change from the present practice, where water rights are often granted without attention to the potential effects on public resources.

A more promising application of the public trust doctrine would define the public's interest in instream resources along the lines of a property right. Native fish, riparian areas, channel health, and so on would, under this application, be recognized as the property of the

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[390](...continued)
Of course, changes to statutory law will require changes to the very tradition of western water itself. As water market expert Steven Shupe notes, "The 'use it or lose it' ethic associated with the prior appropriation doctrine has indeed perpetuated inefficient irrigation methods over the decades. Without a provision that allows the marketing of conserved water, irrigators have little or no incentive to improve their irrigation systems." Shupe, Steven J. (ed.). Water Marketing 1988: The Move to Innovation. University of Denver College of Law: Denver (1988) [at 26].

[391] Impact/Options, at 3-28.

[392] U.C.A. §73-3-8. Arizona is much more adamant about the public nature of its waters: "The waters of all sources, flowing in streams, canyons, ravines, or other natural channels, or in definite underground channels...and of lakes, ponds and springs on the surface belong to the public...." A.R.S. §45-141A.

citizens of each particular state.[393] The state, as well as the courts, would then have to establish the amount of instream water needed to sustain public resources.

The public trust doctrine, in this sense, resembles federal reserved water rights; the needs of public resources are acknowledged, and a mechanism is in place to ensure that the water necessary to support them is available.[394] Most importantly, these public rights would predate any appropriative rights, therefore offering protections impossible to achieve under instream flow laws and other state-level statutory approaches--including the likelihood that past wrongs under the prior appropriation system will be righted.

In order to be successful, the application of the public trust doctrine to the Virgin's waters must begin before the ongoing adjudication process on the river is complete. Any delay in acknowledging the public's interest in, and rights to, the protection of the Virgin and its resources will mean that this opportunity for such protections will be foregone as the river is committed even more to human uses.

Reform at the Federal Level

Part of the failure to recognize the needs, if not the existence, of instream users can be traced to the federal government's failure to enforce and assert laws that could be employed to protect these resources. Much of this failure arises from the fragmented nature of federal oversight in the Virgin River basin. A myriad of agencies and their field offices are active in the basin. The Bureau of Land Management's jurisdiction over public land resources is shared by the Cedar City District and Dixie Resource Area offices in Utah, the Strip District and Shivwits Resource Area offices in Arizona, and the Las Vegas District and Stateline Resource Area offices in Nevada. Fish and Wildlife Service jurisdiction is shared between the Region I (Portland), Region II (Albuquerque), and Region VI (Denver) offices. Finally, ACOE branches

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[393] Under Utah law, for instance, the public is recognized as proprietor of both waters and wildlife. See U.C.A. §73-3-8 and U.C.A. §23-13-3, respectively.

[394] See Dunning, Harrison C. "Instream Flows, the Public Trust, and the Future of the West." In Natural Resources Law Center. Instream Flow Protection in the Western United States: A Practical Symposium. Boulder, Colorado (March 31, 1988).

in Salt Lake City, Albuquerque, and Los Angeles carry jurisdiction in different segments of the Virgin.

This management maze often results in uncoordinated agency action, and can lead to significant delays, or to lack of action entirely, in making and enforcing important decisions. The FWS's failure to designate critical habitat for native fish is one such example. As long as the potential for uncoordinated federal action exists, local planners will be tempted to continue as if federal law does not exist and work instead to claim the river as their own.

While improved management practices at the local and state levels are perhaps reasonable goals, past experience indicates that positive change would be incremental at best, as these agencies have never evinced an intent to emphasize river resource protection over the demands of development interests. Despite their historical shortcomings, the best hope for protecting the Virgin River appears to lie with the federal agencies. What is needed, then, is a cooperative system that unites the various federal entities and yields a coordinated approach to managing and protecting all the values offered by the Virgin River.

The Virgin Interior Basin Authority

When Colonel John Wesley Powell reported back to Congress after his pioneering expeditions through the western domain, he urged that the western states be divided by watershed rather than by the arbitrary delineations of the surveyor. Powell's argument--that the West's aridity would only engender burdensome complexities in multi-jurisdictional river basin management--fell on deaf ears and western state boundaries were carved with straight lines.

Despite the relegation of water adjudicative authority to the states, there are some western river basins over which the Department of Interior (Interior) retains a great deal of authority through its wide-ranging management responsibilities. Perhaps nowhere are the many roles of Interior so intertwined in river basin management as they are on the Virgin River. No interstate compact between Utah, Arizona, and Nevada guides the allocation of its waters, so each state proceeds as if there were no other states with plans to develop the river to support exponential population increases. Because of intrastate over-appropriation and interstate competition for its waters, the Virgin's natural role as lifeblood for some of the region's most biologically diverse communities is all but forgotten.

The values of the Virgin are at stake--not only because of the specific development proposals slated for the basin, but also because of the fragmented nature of the ongoing decisionmaking processes within the disparate Interior agencies operating within the basin. Despite its widespread presence in the basin, the sister agencies of Interior resemble more a dysfunctional family than the coordinated team it should aspire to become. Prior to the interstate allocation of the Virgin's waters, the numerous Interior agencies must join together to identify their roles and define a cooperative, integrated, inter-agency strategy to ensure protection of the Virgin's outstanding natural values.

Such coordination must include the following:

1. Interstate, inter-region, and intra-agency cooperation
   a. BLM's Wild and Scenic River review must recognize the river as one system;
   b. Instream flow filings in each state must be amenable to such protection;
   c. FWS must develop a uniform approach in designating critical habitat and in developing Recovery Plans.

2. Interagency cooperation
   a. BLM and NPS must cooperate in the Wild and Scenic River designation process;
   b. Individual agencies must not authorize actions that could adversely impact special status species;
   c. BLM must manage its holdings to protect national park values, including those at the boundaries of national parks and public lands.

3. Reserved water rights
   a. Interagency cooperation must protect critical areas (e.g., Virgin River North Fork, Lake Mead's Overton Bay) via reserved rights assertions.

4. Interagency cooperation must work to protect areas where water quality is threatened (e.g., North Creek, Halfway Wash).

5. Bureau of Reclamation
   a. BuRec should develop water conservation plans to complement the goals of its sister agencies.

6. In order to protect broad public interest, Interior should work to perfect its position prior to the commencement of negotiations on an interstate compact for the Virgin.

7. All Interior agencies should subscribe to an "ecoshed management" plan that will ensure coordinated development and implementation of resource management plans, specie recovery plans, critical habitat designations, habitat conservation plans, and so on.

The Virgin basin is a basin of opportunity in which the Department of Interior should redefine its role as an ecosystem manager, consistent with the new direction announced under Secretary Babbitt, and embark on the watershed-based ecosystem management envisioned more than a century ago by Colonel Powell. Through this initiative, Interior should devise a basin-wide interagency authority to coordinate the research and management responsibilities of the Interior agencies in the basin, and also devise plans and strategies for the protection of the Virgin's unique values.

In order to serve local interests in the Virgin basin, the Virgin Interior Basin Authority could develop the data that will be essential in the formulation of the interstate compact which will inevitably be developed by the three basin states. The initiative will provide the information which will be necessary in order for Interior to protect the public's stake in the Virgin River as the compact process moves forward. The Virgin basin offers an unparalleled opportunity to develop a pilot project for the coordinated management of Interior's responsibilities on an ecoshed basis.

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Maps and Figures

Appendix
Maps and Figures

Map 1. The Virgin River Basin

Figure 1. Stream Flow & Stream Depletion Chart (UDWR Figure)

Figure 2. Mean Gage Readings: Littlefield, AZ Station

Figure 3. Mean Gage Readings: Hurricane, UT Station

Figure 4. Biological Contaminants: Virgin River and Tributaries

Figure 5. Dissolved Solids and Other Contaminants

Figure 6. Estimated Groundwater Storage: Virgin River Basin, Utah

Figure 7. Total Dissolved Solids in Groundwater: Virgin River Basin, Utah

Figure 8. Special Status Species of the Virgin River Basin Region

Figure 9. Growth Similarities and Projections (WCWCD Graph)

Figure 10. Projected Growth: St. George, Utah

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Figure 12. Projected Water Demand: Washington County, Utah

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Figure 15. Water Demand: Littlefield, Arizona

Figure 16. Projected Growth: Clark County, Nevada

Figure 17. Farms by Operation Type: Washington County, Utah

Figure 18. Irrigated Lands by Crop Type: Washington County, Utah

Figure 19. Agricultural Employment Projections: Washington County, Utah

Figure 20. Employment Projections: Washington County, Utah

Figure 21. Farms by Value of Sales: Washington County, Utah

Figure 22. Farms by Acreage: Washington County, Utah

Figure 23. Estimated Current Irrigation Water Use: Virgin River Basin, Utah

Figure 24. Irrigation Efficiencies: Selected Washington County Irrigators

Figure 25. Water Use/Income Generation: Washington County, Utah

Figure 26. Potential Reservoirs: Virgin River Basin, Utah

Figure 27. Cedar City Transbasin Diversion Project Alternatives

Figure 28. Gage Readings: USGS Quail Creek Station

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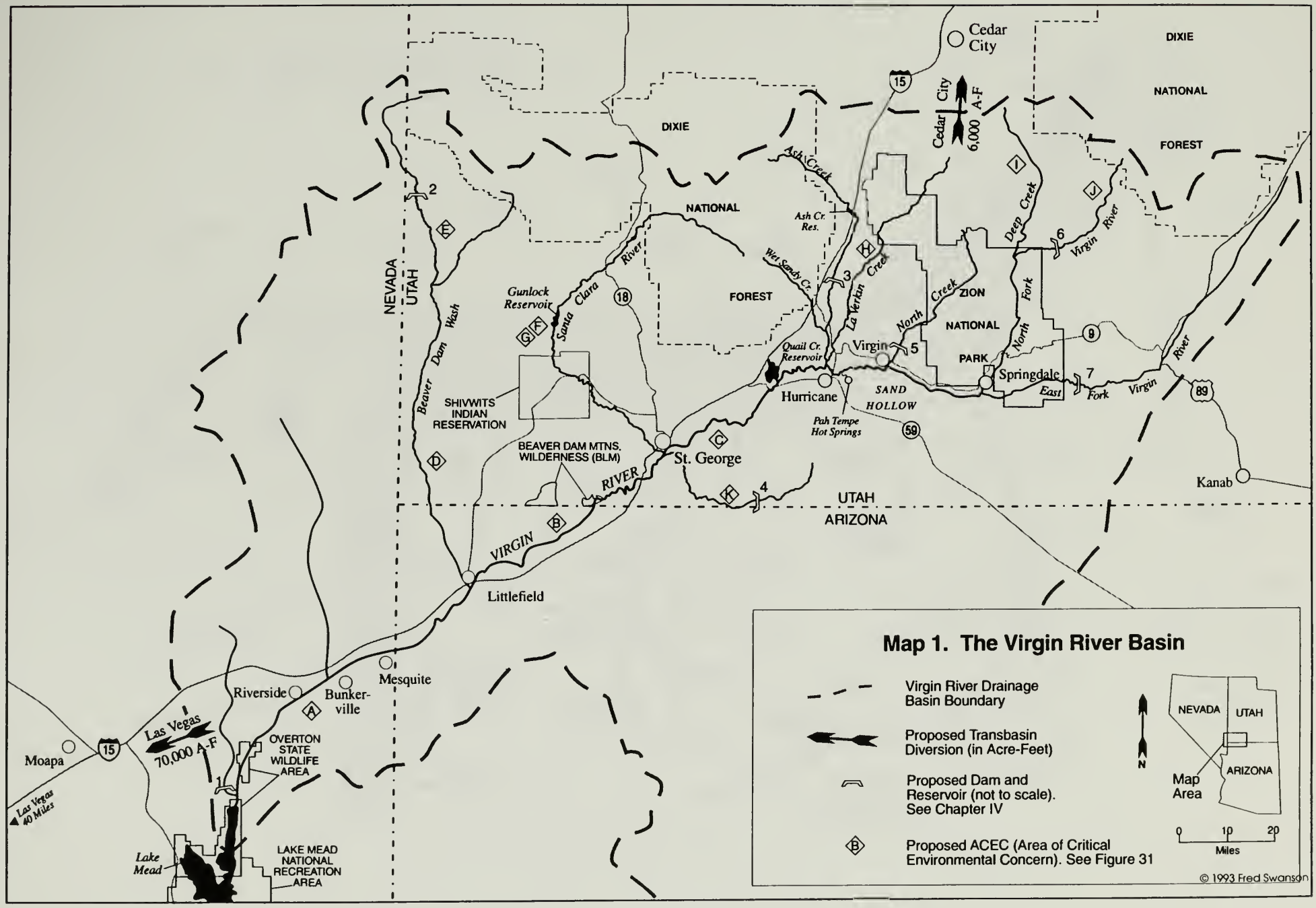
Figure 30. Wild and Scenic River Eligibility Determinations: BLM Dixie Resource Area

Figure 31. Conservationists' Proposal: Areas of Critical Environmental Concern, Virgin River Basin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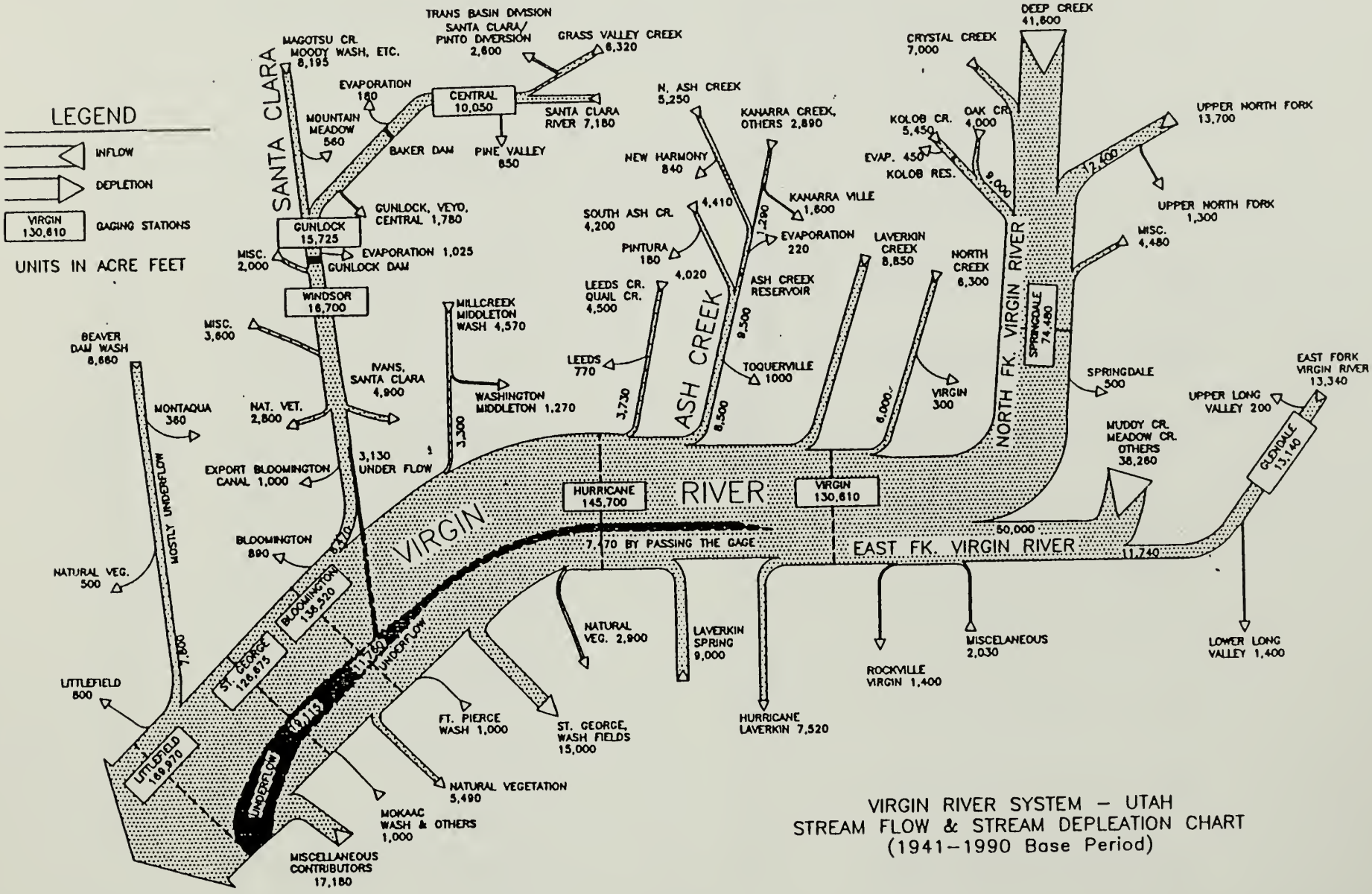
Deep Creek
Virgin River
Gunlock Reservoir
Santa Clara River
Wet Sandy Cr.
La Verkin Creek
North Fork
ZION
NATIONAL
PARK
Quail Cr. Reservoir
Virgin
Springdale
East Fork Virgin River
Beaver Dam Wash
SHIVWITS INDIAN RESERVATION
BEAVER DAM MTNS. WILDERNESS (BLM)
Hurricane
SAND HOLLOW
Pah Tempe Hot Springs
St. George
Kanab
UTAH
ARIZONA
VIRGIN RIVER
Littlefield
Mesquite
Riverside
Bunker-ville
Las Vegas
70,000 A-F
Moapa
OVERTON STATE WILDLIFE AREA
Las Vegas 40 Miles
Lake Mead
LAKE MEAD NATIONAL RECREATION AREA
18
59
89
Map 1. The Virgin River Basin
Virgin River Drainage Basin Boundary
Proposed Transbasin Diversion (in Acre-Feet)
Proposed Dam and Reservoir (not to scale). See Chapter IV
Proposed ACEC (Area of Critical Environmental Concern). See Figure 31
N
NEVADA
UTAH
ARIZONA
Map Area
0 10 20
Miles
© 1993 Fred Swanson



VIRGIN RIVER SYSTEM – UTAH
STREAM FLOW & STREAM DEPLEATION CHART
(1941–1990 Base Period)

Figure 2.
Mean Gage Readings: USGS Station #09415000 (Virgin River at Littlefield, AZ)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	227.4	246.6	333.8	419.4	212.6	103.8	132.9	155.0	114.4	229.3	271.8	271.0
1982	232.6	246.3	359.9	354.4	358.4	96.2	95.7	233.3	189.3	186.5	187.7	196.5
1983	291.6	347.5	1645	1135	1952	1119	266.4	386.6	190.2	196.4	294.0	504.2
1984	293.1	256.2	225.0	283.1	224.5	95.7	294.9	301.1	157.3	320.3	315.0	389.9
1985	287.6	281.8	360.9	608.9	344.4	84.9	91.5	76.4	90.6	185.4	223.7	274.8
1986	236.4	311.9	268.9	240.8	183.2	92.4	84.7	103.2	251.7	129.4	223.9	260.8
1987	141.2	147.5	179.9	336.4	192.6	101.8	151.9	140.4	90.1	275.4	230.7	171.1
1988	245.9	250.7	233.4	525.3	401.7	150.4	84.1	337.8	186.0	179.4	353.8	199.9
1989	540.0	221.5	263.6	86.6	59.5	62.1	61.6	128.2	91.5	120.8	157.1	215.0
1990	197.5	143.6	100.6	78.6	49.9	56.4	58.5	94.8	171.1	117.3	135.5	159.5
1991	124.2	110.1	163.6	100.6	83.2	68.7	62.7	73.6	103.0	93.4	100.9	119.3
1992	161.3	273.7	421.9	418.3	220.5	77.6	71.6	123.5	109.1	95.1	127.1	150.4

Figure 3.
Mean Gage Readings: USGS Station #09408150 (Virgin River near Hurricane, UT)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	169	190	252	383	219	110	133	118	113	167	179	186
1982	192	212	283	370	391	98	85	173	179	154	136	179
1983	208	302	765	721	1657	869	248	316	169	116	191	349
1984	252	221	203	274	244	101	180	199	122	217	227	289
1985	197	201	270	637	229	97	116	87	79	146	164	206
1986	176	222	262	258	183	162	103	102	254	62	141	164
1987	70	86	109	240	175	109	118	106	77	304	148	51
1988	169	184	188	475	396	141	89	205	164	92	280	94
1989	662	---	---	---	---	---	---	---	---	71	81	192
1990	**NO DATA FOR 1990**											
1991	59	60	113	85	82	74	72	78	74	54	56	59
1992	90	151	289	340	217	82	86	103	101	82	73	91

Figure 4
Biological Contaminants: Virgin River and Tributaries

Site Name	Fecal Coliform*	Fecal Strep*
Virgin River (at Bloomington)	6,200	9,300
Santa Clara River (mouth)	2,400	2,100
Santa Clara River (below Veyo Hot Springs)	2,400	550
Veyo Hot Springs	<1	<1
Santa Clara River (below Right Fork confluence)	30	480
Santa Clara River (above campground)	90	300
Fort Pearce Wash (mouth)	5,000	6,000
Mill Creek (below Washington)	20,000	6,500
Leeds Creek (mouth)	>120	1,200
Virgin River (above Leeds)	500	1,600
Gould Wash (mouth)	26,000	44,000
Virgin River (below Ash Creek)	1,200	1,800
Ash Creek (near Toquerville)	30	230
LaVerkin Creek (mouth)	500	1,800
LaVerkin Hot Springs	20	5
Virgin River (at Virgin)	1,300	3,700
North Creek (mouth)	1,400	1,300
North Fork (above confluence)	1,500	1,800
North Fork (near Springdale)	80	350
East Fork (above confluence)	60	470
East Fork (at Mt. Carmel Junction)	1000	790
East Fork (near Glendale)	>120	>200

* Colonies per 100 ml

Figure 5
Dissolved Solids and Other Contaminants*

Site	TDS Range	TDS Average	Susp. Solids Range	Susp. Solids Average	Total Average Load
Virgin River (above first narrows)	780-3990	1898	4-13,200	1627	3525
Santa Clara River (above Virgin River)	302-2138	1347	16-3090	258	1605
Virgin River (above treatment plant)	710-3510	1445	8-9999	1570	3015
Virgin River (at I-15 crossing, Hurricane)	430-2964	1459	26-7220	791	2250
Ash Creek (at Hwy. 17 crossing, Toquerville)	200-590	436	3-26,250	1152	1588
LaVerkin Creek (at Hwy. 17 crossing)	292-1792	794	8-19,350	1005	1799
Virgin River (west of Virgin, UT)	240-588	451	15-40,940	1706	2157
Virgin River (at Rockville)	298-660	432	71-4440	1393	1825
Virgin North Fork (above confluence)	194-568	374	7-5560	387	761
Virgin North Fork (below Zion Narrows)	204-562	317	7-1260	180	497
Virgin East Fork (above confluence)	204-1136	384	12-91,720	2916	3300
Virgin East Fork (at Hwy. 89 crossing)	396-1986	701	197-9999	2449	3150
Virgin East Fork (north of Glendale)	220-376	282	4-94	16	298

* All data expressed in milligrams per liter (mg/l).

Figure 6.
Estimated Groundwater Storage: Virgin River Basin, Utah

Site	Area (acres)	Thickness (feet)	Stored (acre-feet)	Available (acre-feet)
Central Basin (unconsolidated)				
New Harmony Valley	23,700	300	2,100,000	1,050,000
Fort Pearce Wash	1,500	100	30,000	15,000
Santa Clara River Valley	1,300	50	10,000	5,000
Pine Valley	1,000	75	20,000	10,000
Anderson Junction	100	100	3,000	1,500
Leeds	300	30	2,000	1,000
Totals			**2,170,000**	**1,080,000**
Central Basin Navajo Aquifer				
Gunlock outcrop area	9,300	620	980,000	490,000
St. George outcrop area	49,600	700	5,900,000	2,950,000
Leeds outcrop area	30,000	360	1,800,000	900,000
Hurricane outcrop area	40,500	430	3,000,000	1,500,000
Buried areas	230,000	2,200	86,000,000	1,360,000
Totals			**97,700,000**	**7,200,000**
Upper Basin Navajo Aquifers				
Outcrop areas	190,000	300	9,000,000	4,500,000
Buried areas	380,000	2,000	100,000,000	25,000,000
Totals			**109,000,000**	**30,000,000**

(Totals may not sum due to rounding.)

Figure 7.
Total Dissolved Solids in Groundwater: Virgin River Basin, Utah

Site	Springs	Alluvial Aquifers	Navajo Aquifer	Other Rock Aquifers
Central Virgin River				
Ash Creek Valley	---	410	---	630
Snow Canyon	---	---	110-130	---
Diamond Valley	---	---	---	210
Fort Pearce Wash	---	3300	---	---
Gunlock	---	---	290-470	---
Hurricane Bench	1300	830	---	---
Leeds/Harrisburg Junction	---	1000	230	---
Mill Creek/City Creek	330	---	380-960	1300
New Harmony Valley	240	410-1610	---	---
Pine Valley	---	150	---	---
St. George Valley	---	---	820	902-4000
Santa Clara/Ivins Bench	---	230	---	470-4070
Triangle Valley/Warner Valley	---	---	---	3100-3400
Virgin River Valley	---	1180-6860	---	1400
Washington Valley	435	---	---	---
Santa Clara Valley	---	190-2620	---	---
Upper Virgin River				
Gould Wash	---	1080-3440	---	---
Clear Creek/North Fork	230	870	---	---
Glendale	150	320	---	---
Orderville	---	550	---	---
Rockville	---	400-2000	---	---
Springdale	---	1100	---	---
near Long Valley Junction	---	290-310	---	---
LaVerkin Creek	620	---	---	---
LaVerkin Springs	9400	---	---	---

All figures are expressed in milligrams per liter (mg/l).

Figure 8.
Special Status Species of the Virgin River Basin Region

Alpine watsonii
Amargosa Naucorid Bug
Amargosa Tryonia Snail
American Bittern
Arizona Southwestern Toad
Ash Meadows Amaragosa Pupfish
Ash Meadows Naucorid
Ash Meadows Pebblesnail
Ash Meadows Speckled Dace
Ash Meadows Vole
Atwood Catseye
Atwood Wild Buckwheat
Bald Eagle
Barneby Milkvetch
Beaked Milkvetch
Beath Milkvetch
Belted Kingfisher
Big Dune Aphodius Scarab Beetle
Blackrock Ground Daisy
Bonytail Chub
Blue Curls
Brady Plains Cactus
California Leaf-Nosed Bat
Carole's Silverspot Butterfly
Chuckwalla
Common Black Hawk
Crystal Spring Springsnail
Desert Rose
Desert Tortoise
Devil's Claw
Devil's Hole Pupfish
Devil's Hole Warm Springs Riffle Beetle
Distal-Gland Springsnail
Dwarf Bearclaw Poppy
Elongate-Gland Springsnail
Fairbanks Springsnail
Ferruginous Hawk
Fickeisen Navajo Cactus
Grand Canyon Cave Psuedoscorpion
Grand Wash Springsnail
Giuliani's Due Scarab Beetle
Grated Tryonia
Gumbo Milk-Vetch
Gypsum Cactus
Heerman Wild Buckwheat
Hermit Catseye
Hidden Horn Milkweed
Holmgren Milk-Vetch
Hopi Sage
Hooker Balsam Root
Hopi Sunflower
James Whitlow Wort
Jones Blue Star
Jones Golden Aster
Juniper Buttercup
King Clover
King Snapdragon
Large Aeglallan Scarab Beetle
Least Evening Primrose
Littlefield Nama
Long-Billed Curlew
Longspine Cotton Thorn
MacNeill Sooty Wing Skipper
Meadow Valley Wash Desert Sucker
Meadow Valley Wash Speckled Dace
Median-Gland Nevada Springsnail
Merriam's Kangaroo Rat
Mexican Spotted Owl
Minute Tryonia Snail
Moapa Dace
Moapa Roundtailed Chub
Moapa Pebblesnail
Moapa Speckled Dace
Moapa Warm Springs Riffle Beetle
Moapa White River Springfish
Mohave Dalea
Morand's Checkerspot Butterfly
Mt. Trumbull Beardtongue
Mountain Plover
Narrowleaf Blue Star
Navajo Bridge Cactus
Nevada Bluegrass
Nevada Moonpod
Nodesten Sunray

Figure 8 (continued)

Northern Goshawk
Northern Leopard Frog
Oasis Valley Springsnail
Pahrump Killifish
Palmer's Chipmunk
Parney Wild Parsley
Peregrine Falcon
Point of Rocks Tryonia Snail
Razorback Sucker
Red Alum Root
Red Bat
Relict Leopard Frog
Roaring Spring Prickle Poppy
Rulien's Miloderes Weevil
Scarlet Wild Buckwheat
Shrub Gilia
Siler Pincushion Cactus
Silver Buffalo Berry
Silverleaf Sunray
Slender Evening Primrose
Snowy Egret
Southwest Willow Flycatcher
Southwestern Otter
Sportinggoods Tryonia Snail
Spotted Bat
Spotted Owl
Spotted Warner Valley Dunes Beetle
Spring Mountain Blue Butterfly
Striped Flower Milkvetch
Three Hearts
Two-Leaf Bedstraw
Utah Chaetarthria Water Scavenger Beetle
Utah Coryphantha
Utah Hydroporus Diving Beetle
Utah Minute Moss Beetle
Utah Spikemoss
Vagabond Pasnip
Virgin Narrows Spike Moss
Virgin Phacelia
Virgin River Chub
Virgin River Montane Vole
Virgin River Spinedace
Virgin River Thistle
Virile Amargosa Snail
Warm Springs Pupfish
Welsh's Milkweed
Western Snowy Plover
Whipple Opuntia
White-Faced Ibis
Woundfin Minnow
Yellow Beavertail
Zion Tansy
no common name (Asplenium andrewsii)
no common name (Erigeron sionis)

Growth Similarities & Projections

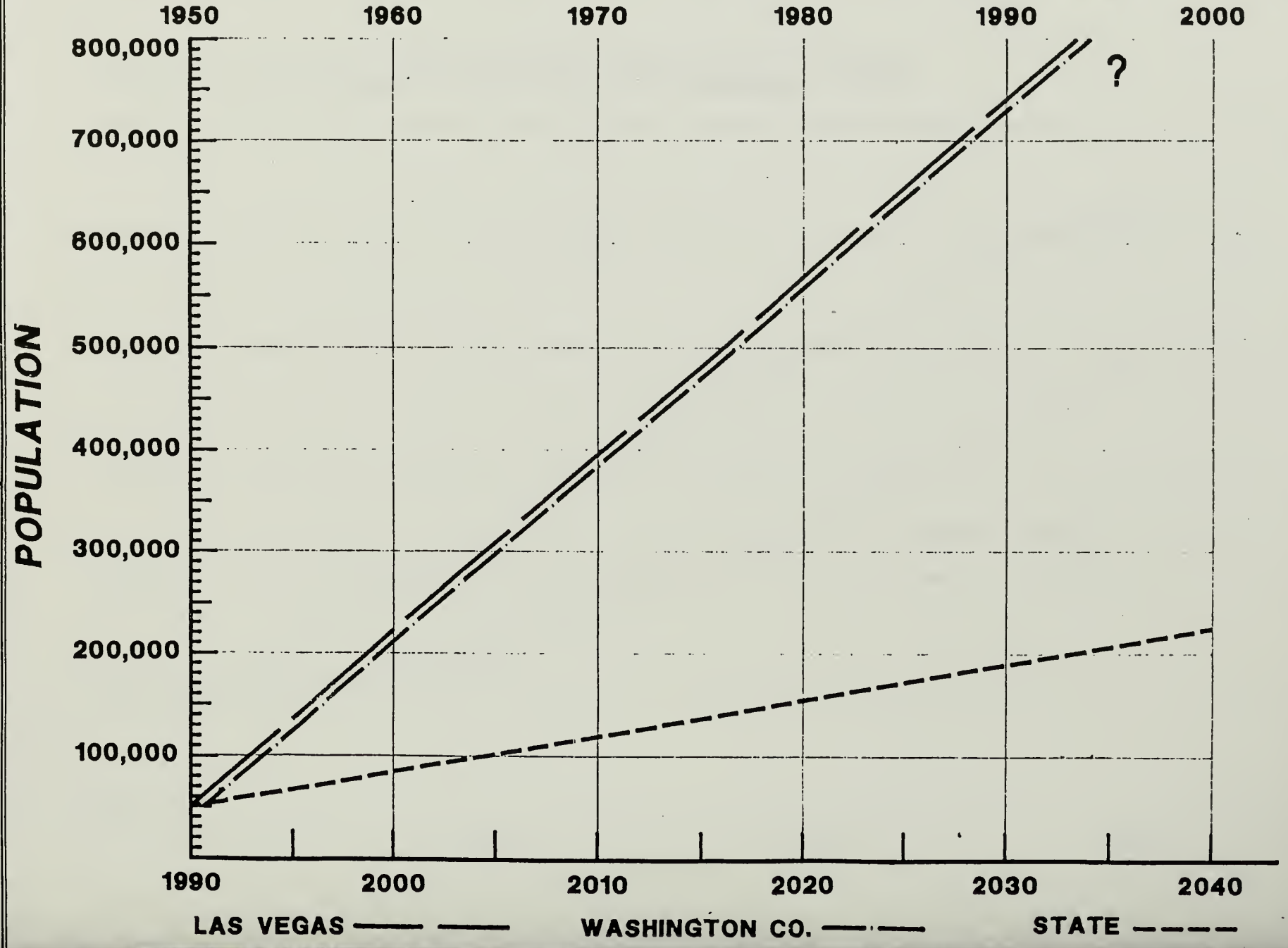


Figure 10. Projected Growth: St. George, Utah

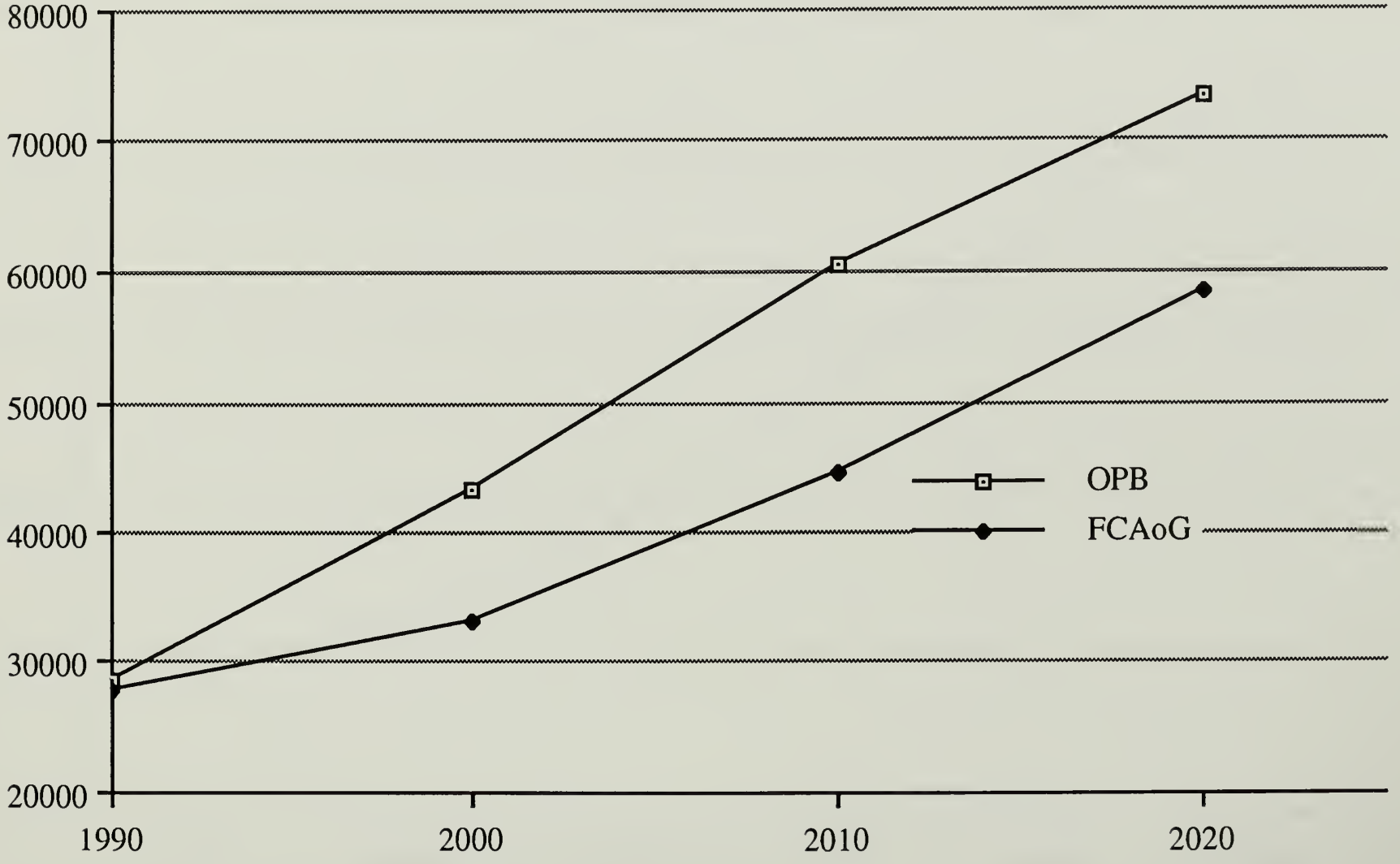


Figure 11. Projected Growth: Cedar City, Utah

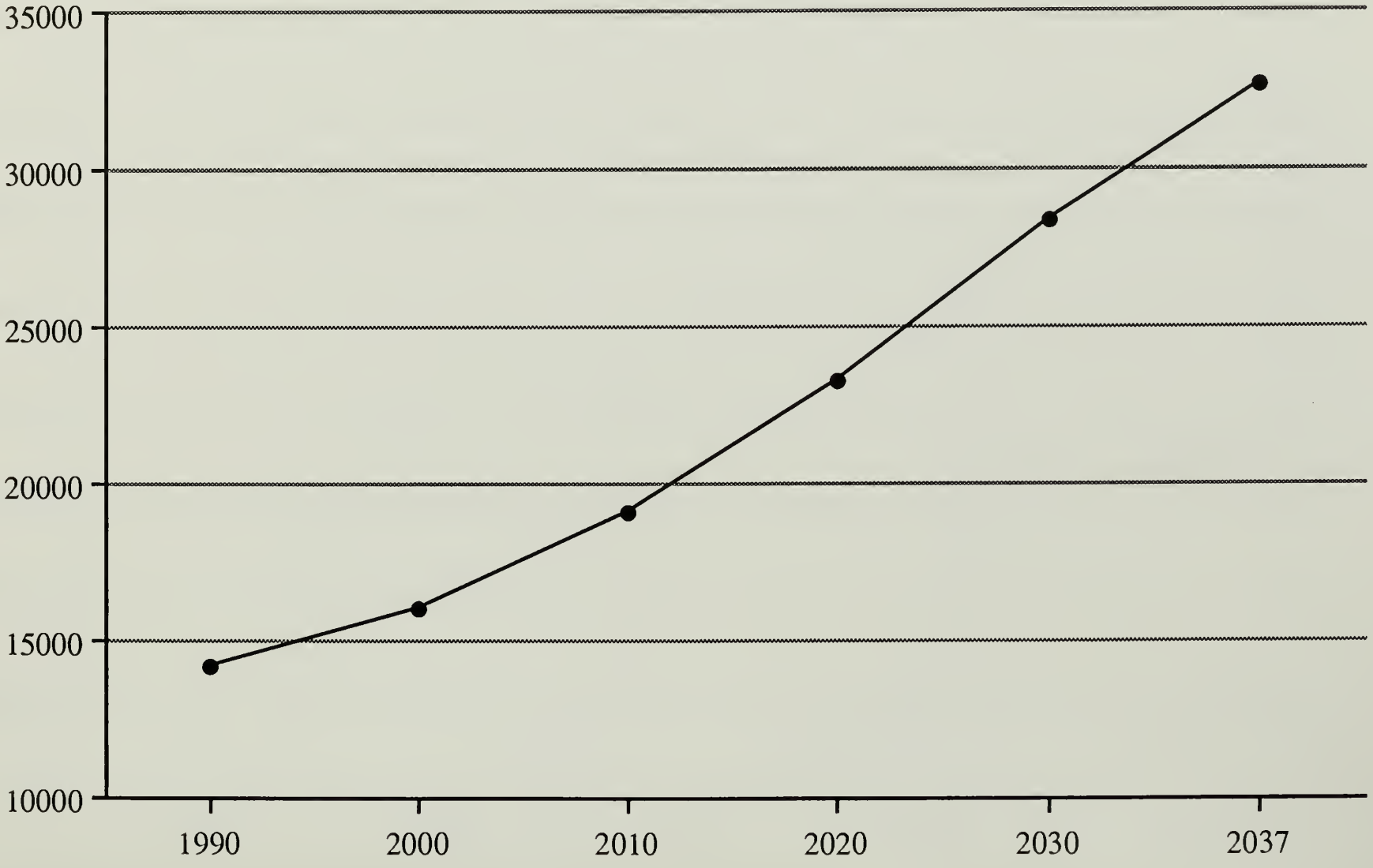


Figure 12. Projected Water Demand: Washington County, Utah

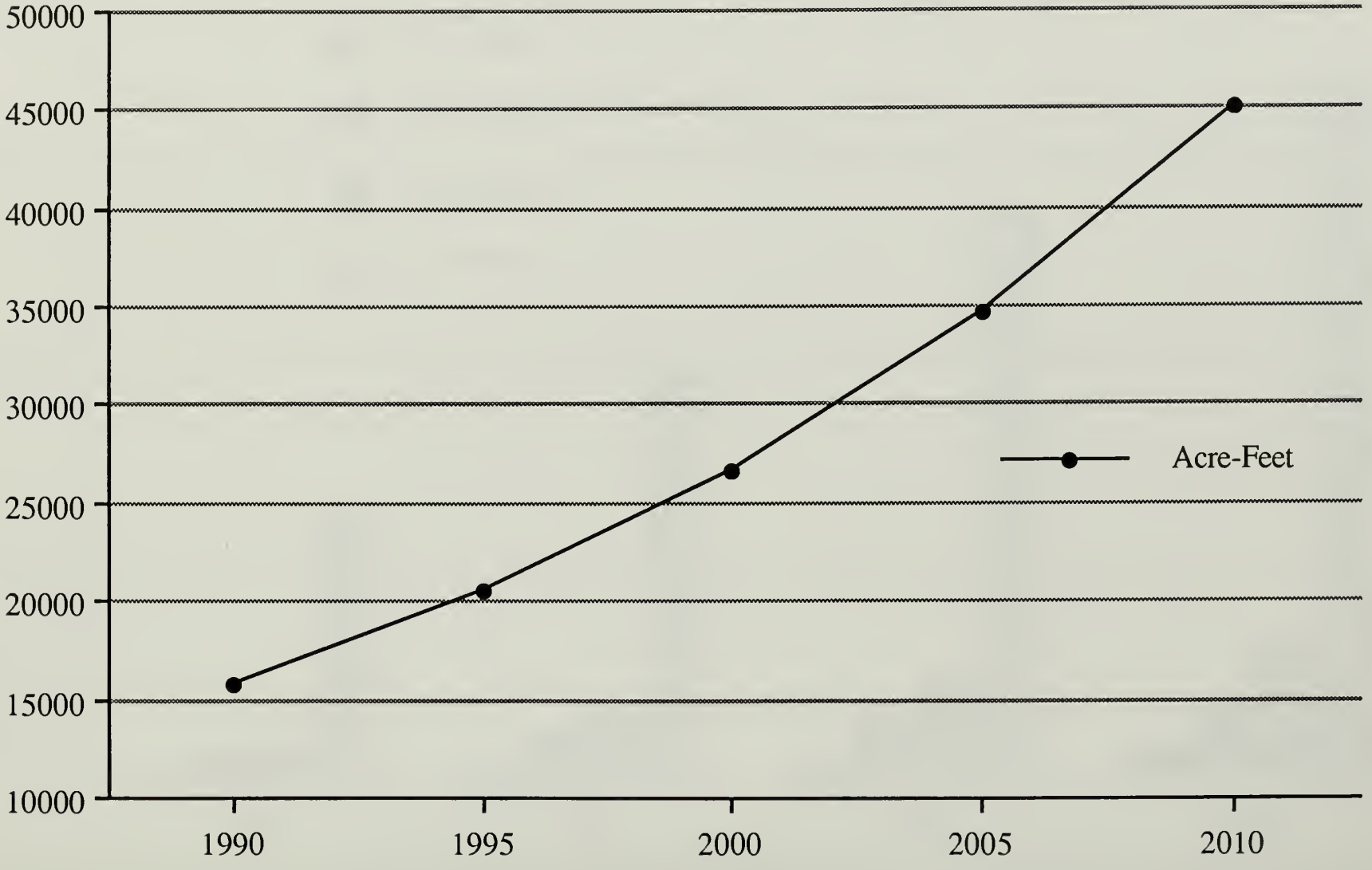


Figure 13. Projected Water Demand: Washington County Communities

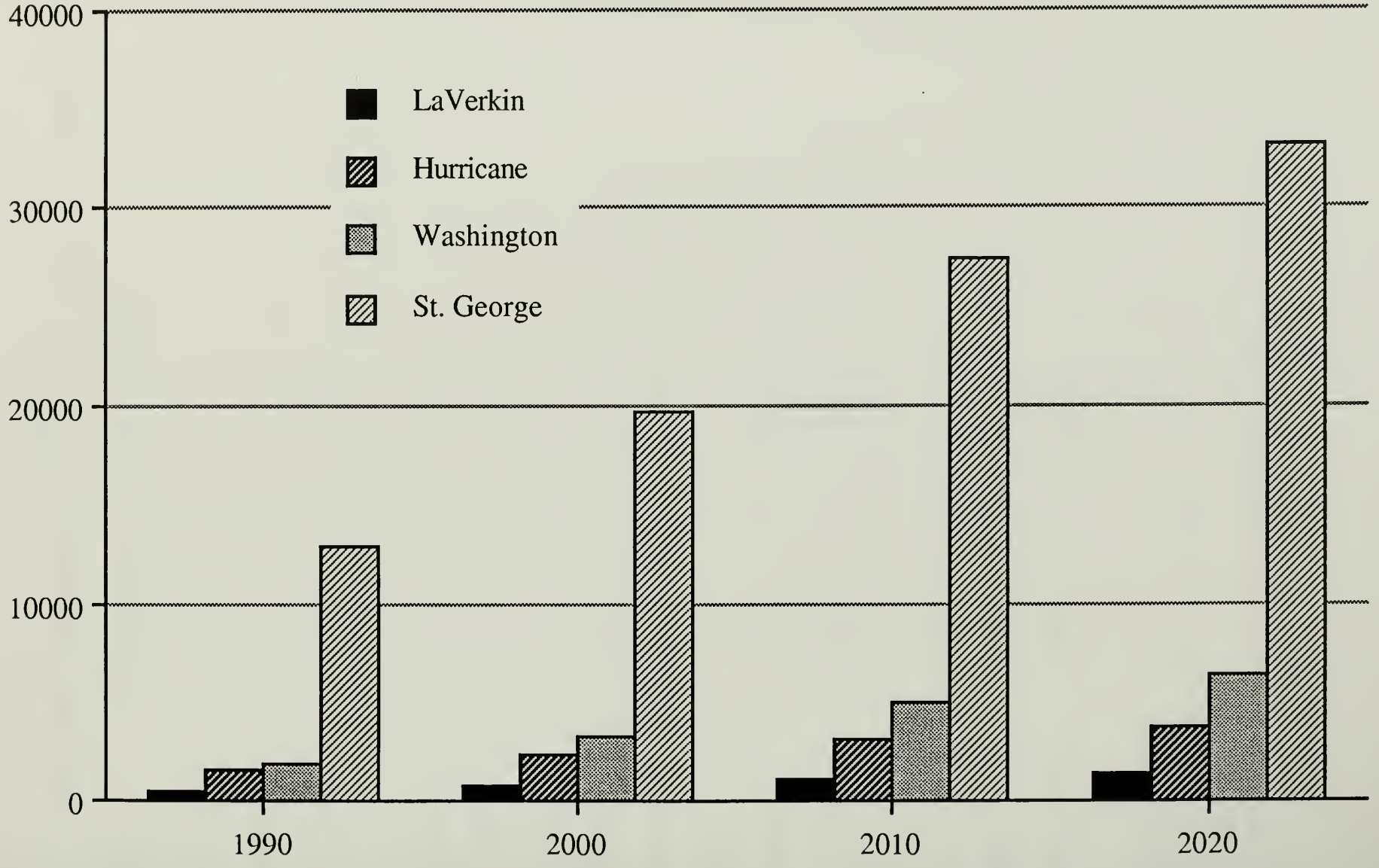


Figure 14.
M&I Water Diverted (Gallons Per Capita Day): Virgin River Basin, Utah

City	1990 Population	Diversions (GPCD)
Glendale	282	152(a)
Orderville	422	211(b)
Springdale	275	361
Rockville	182	199
Virgin	229	147
Kanarraville	228	337
New Harmony	101	381
Toquerville	488	158(c)
LaVerkin	1,771	245
Hurricane	3,915	366
Leeds	254	371
Washington	4,198	389(a)
St. George	28,502	404
Ivins	1,630	197
Santa Clara	2,322	314
Hildale	1,325	153(d)
Unincorporated	2,209	367(e)

(a) 1989 figure
(b) 1988 figure
(c) 1989 figure (228)
(d) 1985 figure
(e) 1979 figure (Central) and 1985 figure (Pintura) included

Figure 15. Water Demand, Littlefield, AZ

Figure 16. Projected Growth: Clark County, Nevada

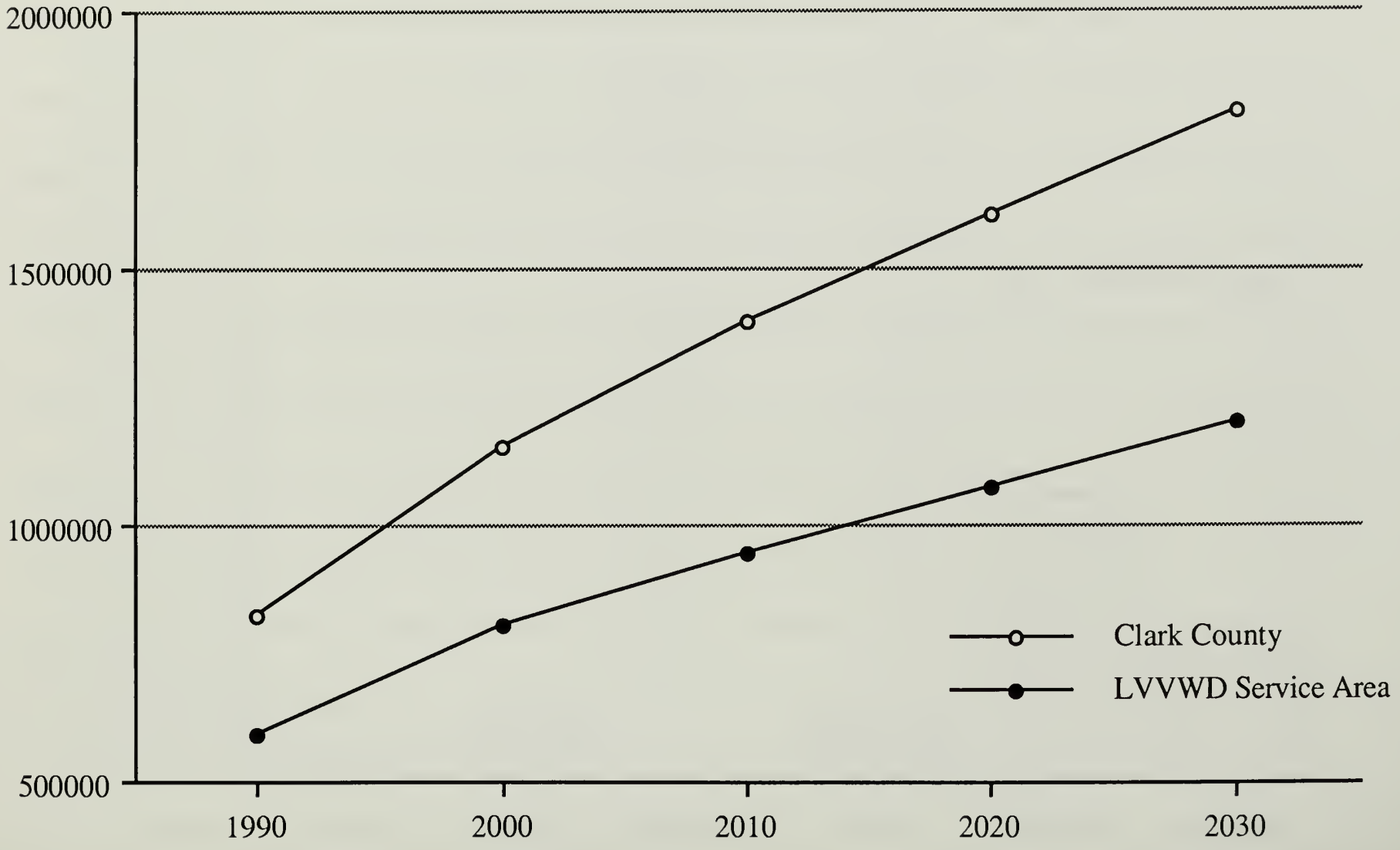


Figure 17. Farms by Operation Type: Washington County, Utah

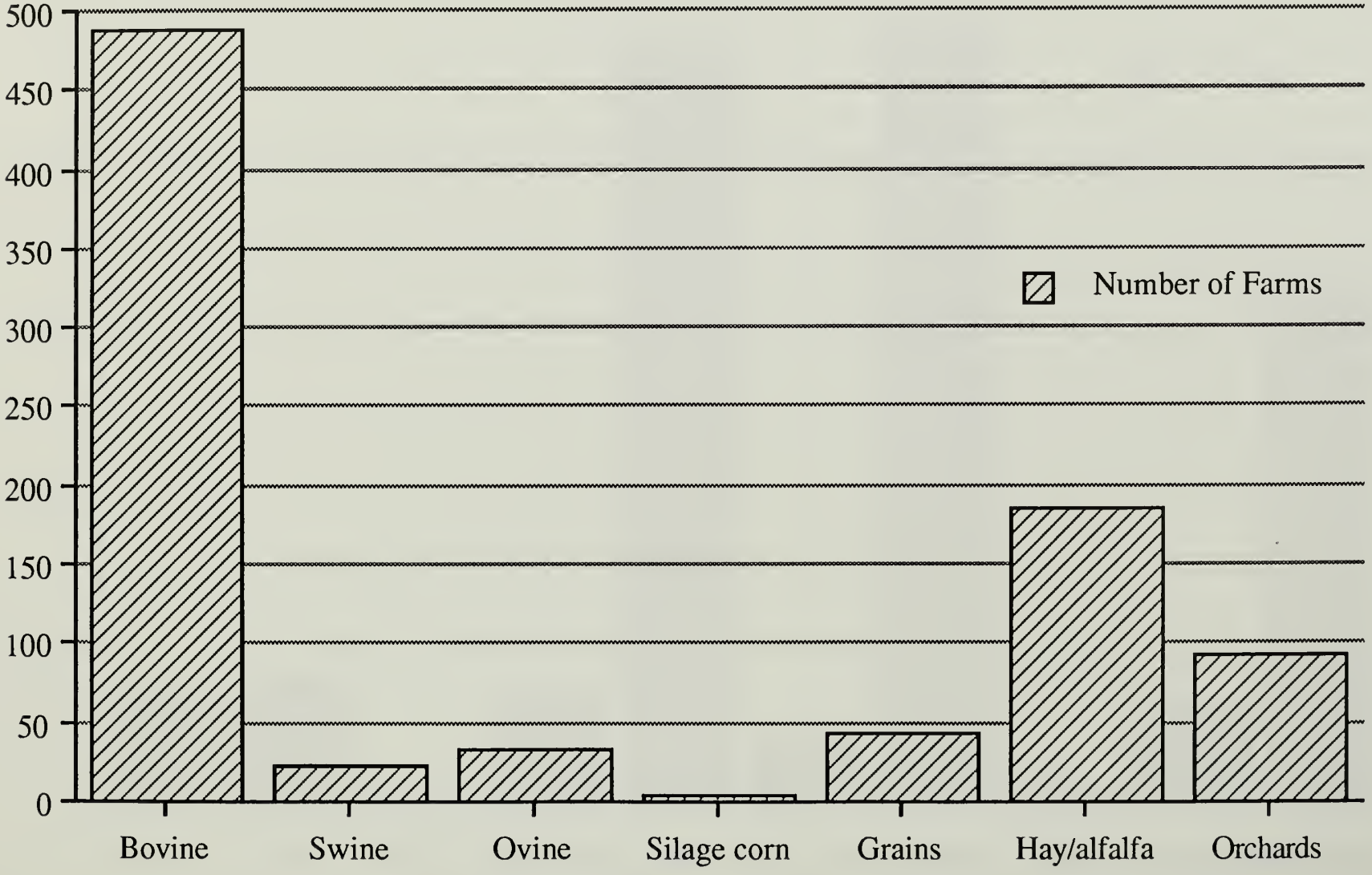


Figure 18. Irrigated Lands by Crop Type: Washington County, Utah

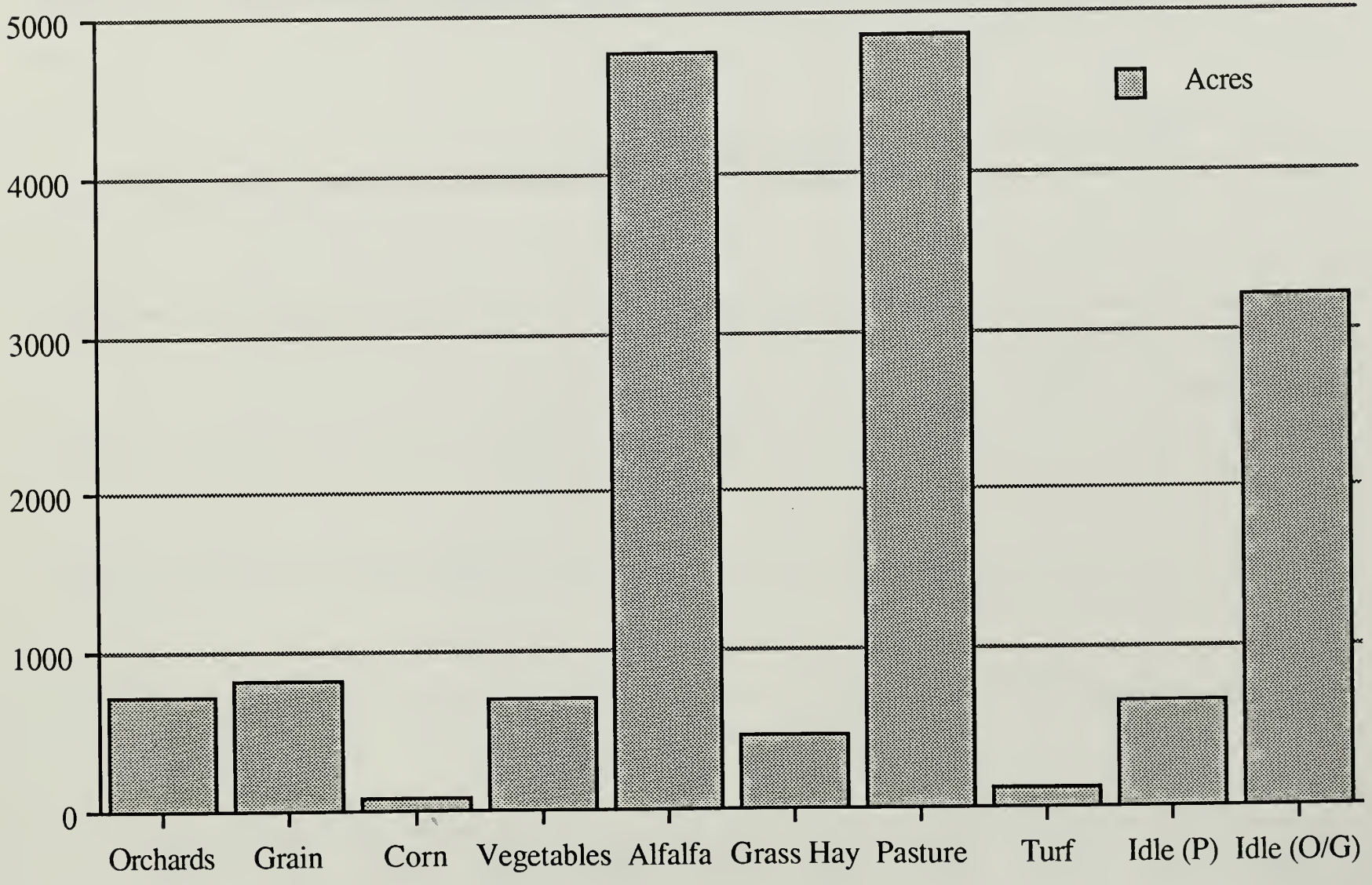


Figure 19. Agricultural Employment Projections: Washington County, Utah

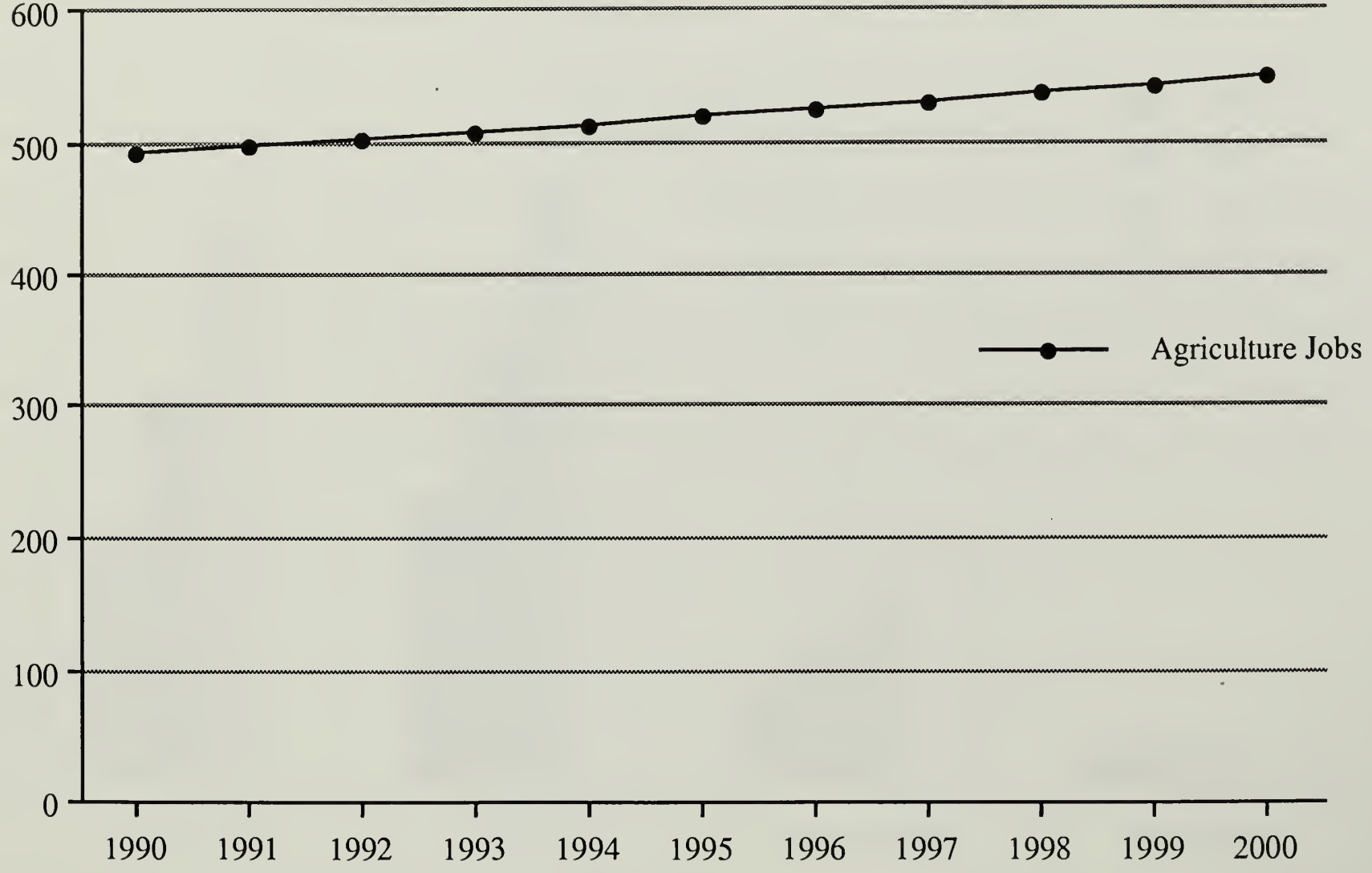


Figure 20. Employment Projections: Washington County, Utah

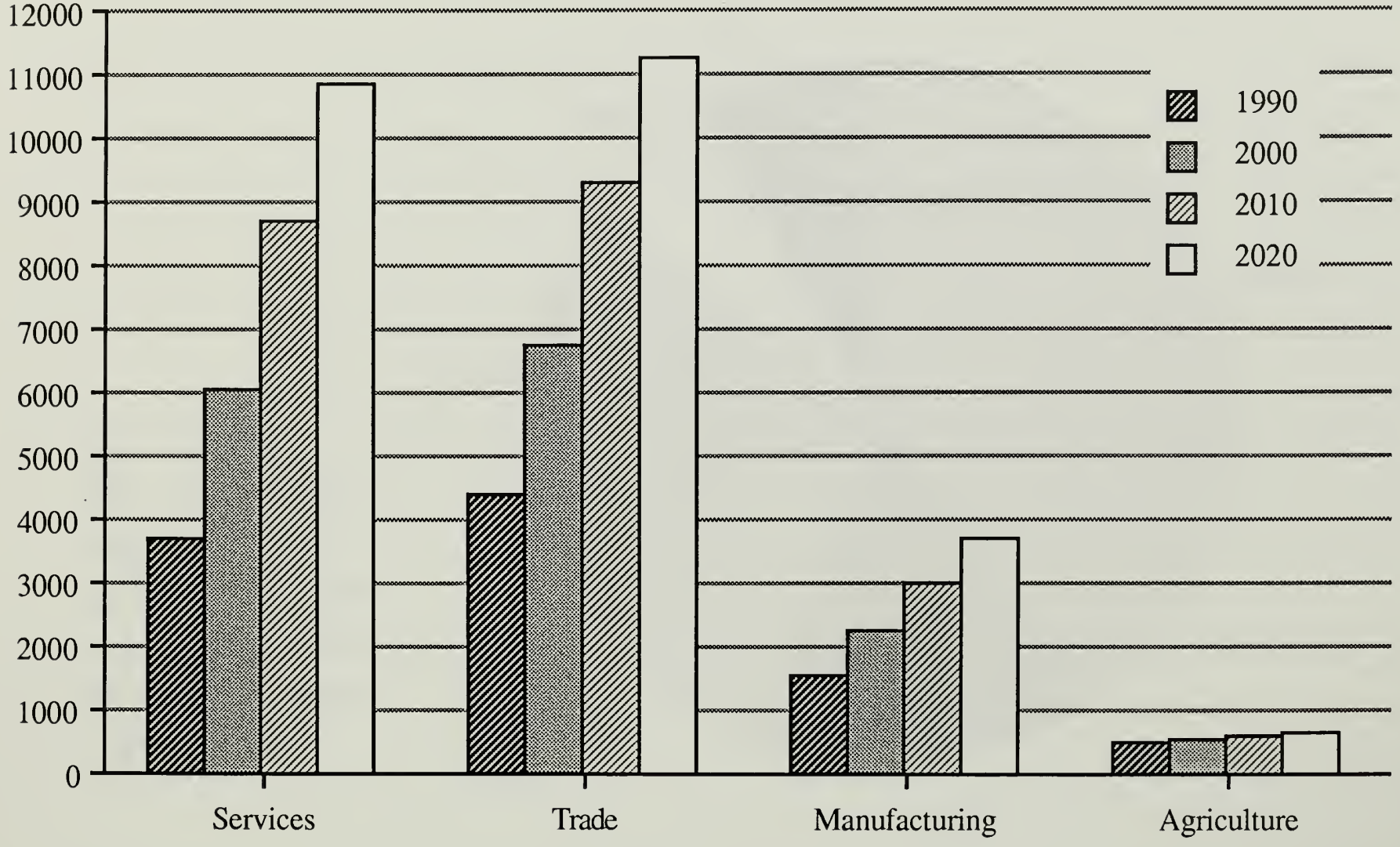


Figure 21. Farms By Value of Sales: Washington County, Utah

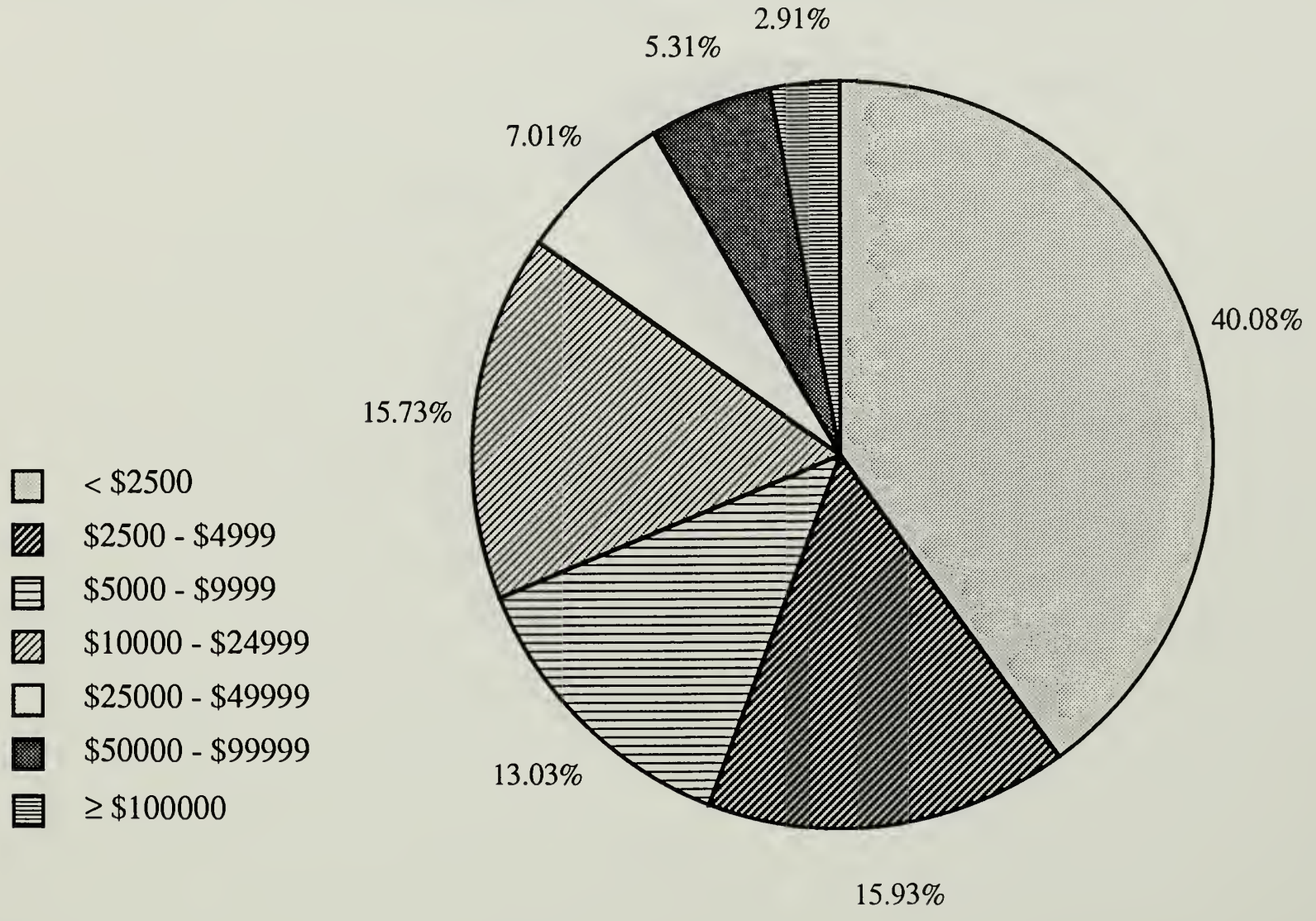


Figure 22. Farms by Acreage: Washington County, Utah

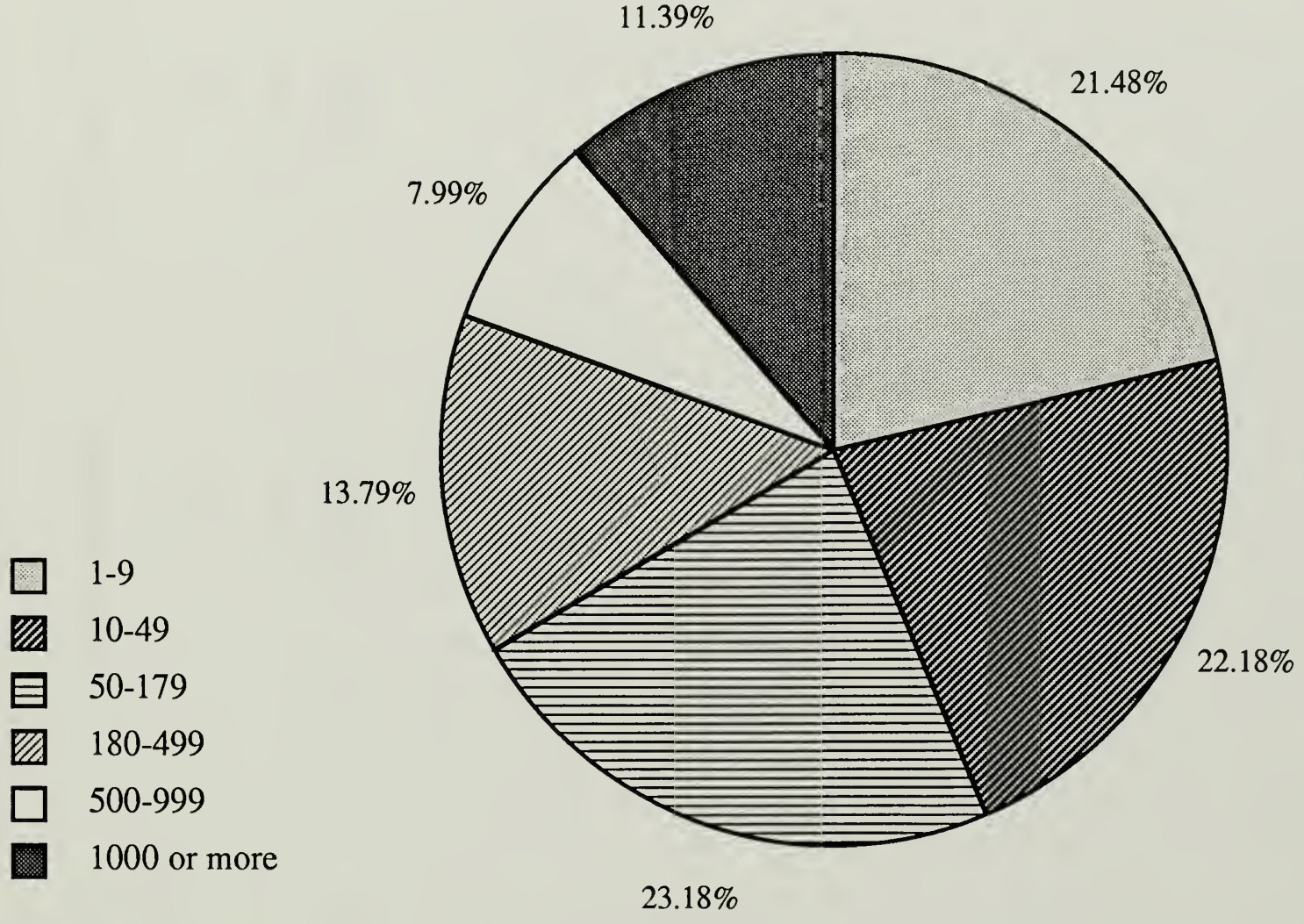


Figure 23.
Estimated Current Irrigation Water Use: Virgin River Basin, Utah

County	Diversions (acre-feet)	Depletions (acre-feet)
Washington	87,789	39,287
Iron	7861	1492
Kane	27,641	10,485
Totals	**123,291**	**51,264**

Figure 24. Irrigation Efficiencies: Selected Washington County Irrigators

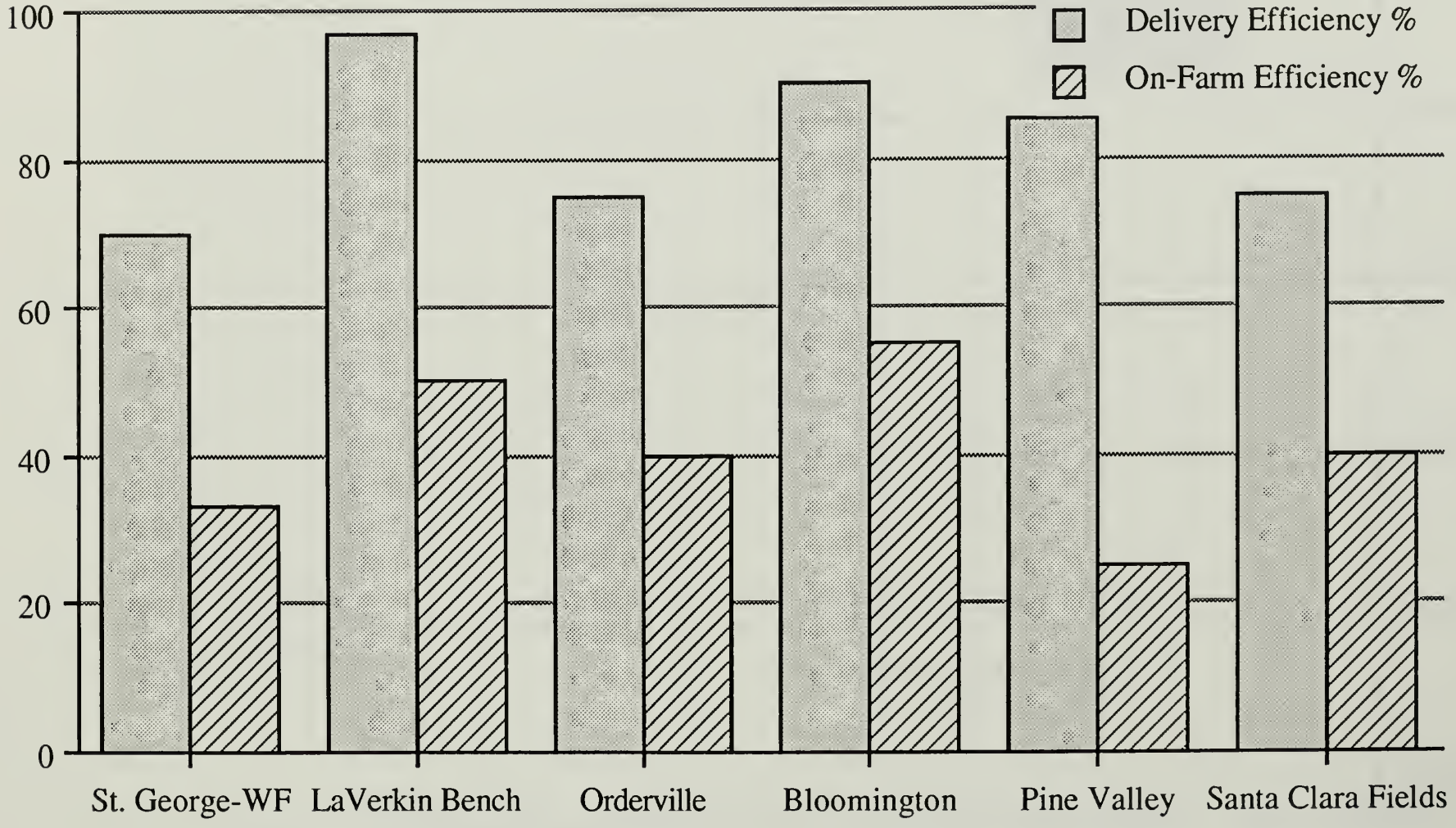


Figure 25. Water Use/Income Generation: Washington County, Utah

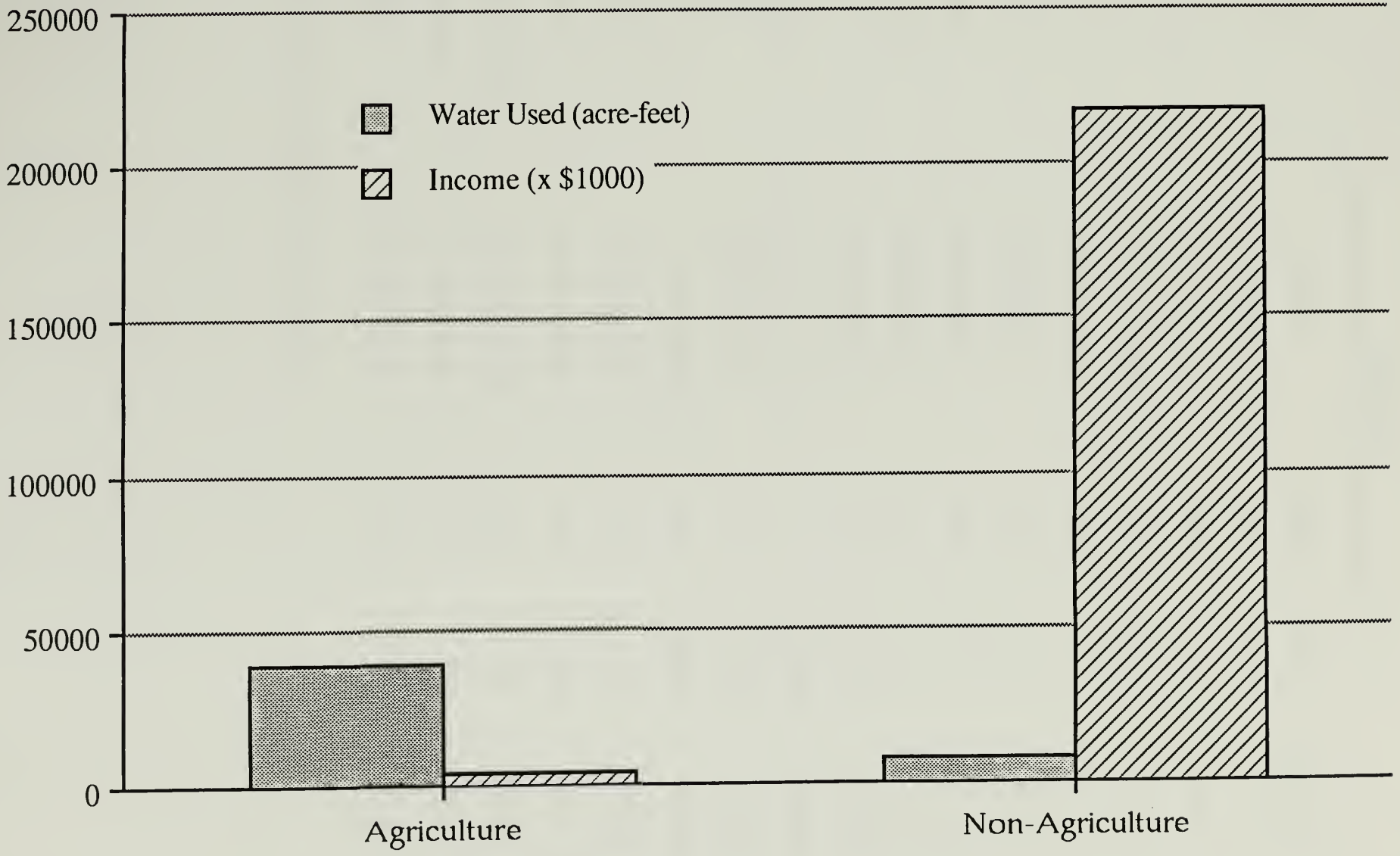


Figure 26.
Potential Reservoirs: Virgin River Basin, Utah

Site Name	Location	Height	Length	Storage/AF
Stout Creek	T39S/R7W/§§35-36	170	840	6,000
Lydia's Canyon	T40S/R7W/§11	210	1,600	12,000
Muddy Creek	T41S/R7-8W/§§7, 12	130	1,700	12,500
Long Valley	T41S/R8W/§36	115	750	19,000
East Fork	T42S/R8W/§7	150	300	12,000
Seth Canyon	T38S/R8W/§31	150	1,300	5,000
Hay Canyon	T39S/R8W/§18	150	850	3,000
Bulloch	T39S/R9W/§32	144	650	8,500
North Creek	T41S/R12W/§§14, 23	125	1,400	13,500
LaVerkin	T40S/R12W/§19	155	800	5,000
Warner Valley	T42S/R14W/§§28-29	240	3250	55,000
Fort Pearce	T43S/R14W/§34	110	700	16,000
Santa Clara	T41S/R17W/§28	150	800	22,000
Lower Santa Clara	T42S/R16W/§18	190	700	18,000
Beaver Dam	T38S/R20W/§25	190	450	18,000
Gunlock*	T41S/R17W/§5	142	1,550	16,800

* Enlargement of existing dam and reservoir.

Figure 27.
Cedar City Transbasin Diversion Project Alternatives

ALT	Description	Construction Cost	Cost Per Acre-Foot
A1	Kolob Reservoir w/Crystal Creek Cedar Pipelines	$33.9M	$4,470
B1	Kolob Reservoir/Cedar City pipeline (11 cfs)	9.9M	1,238
B2	Kolob Reservoir/Cedar City pipeline (19 cfs)	12.8M	1,611
C1	Upper Virgin Springs/Cedar City Pipeline (Alignment #1)	14.8M	890
C2	Upper Virgin Springs/Cedar City Pipeline (Alignment #2)	15.5M	985
C3	Upper Virgin Springs/Cedar City Pipeline (Low collection)	47.5M	6,504
D1	Upper Virgin Springs/Cedar City Pipeline (4.5 cfs)	13.7M	1,460

Figure 28.
Gage Readings: USGS Station #09408135 (Above Quail Creek, Near Hurricane, Utah)

1989 Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	---	---	88	86	51	49	48	44	35	50	e115	49
02	---	---	240	88	64	51	49	44	36	49	e82	49
03	---	---	499	84	48	50	51	31	41	50	e80	49
04	---	---	149	75	49	56	48	30	42	44	e76	47
05	---	---	98	71	50	55	45	48	34	48	e70	46
06	---	---	105	69	50	51	37	44	36	52	e64	47
07	---	---	116	70	51	52	43	37	38	51	e58	46
08	---	---	139	73	51	51	42	35	38	52	e55	46
09	---	---	165	73	46	53	42	43	37	54	e52	46
10	---	---	179	71	47	55	42	48	41	54	e49	46
11	---	---	169	66	53	58	39	48	43	55	e49	46
12	---	---	158	60	61	56	41	50	36	53	e48	47
13	---	---	168	57	58	49	40	47	39	57	e45	48
14	---	---	144	54	69	49	38	44	40	58	e45	52
15	---	e65	118	55	59	44	42	40	39	54	e45	51
16	---	e65	122	52	61	42	37	41	44	64	e46	50
17	---	e68	118	51	59	44	33	45	50	67	46	49
18	---	e71	106	51	59	42	28	368	66	60	48	49
19	---	e75	96	53	59	46	33	e70	e54	66	47	45
20	---	e80	91	54	57	40	31	e58	e53	63	48	44
21	---	e81	79	55	57	36	27	e53	54	79	49	44
22	---	e71	68	53	56	40	33	49	50	123	46	45
23	---	e85	67	53	52	49	36	45	53	e117	46	43
24	---	e90	67	54	54	49	42	42	53	91	46	45
25	---	e96	67	54	60	43	37	40	53	84	46	45
26	---	e98	216	53	58	44	34	41	49	127	46	46
27	---	e115	119	54	58	48	61	45	51	129	49	46
28	---	98	80	55	50	49	163	42	49	124	48	46
29	---	---	87	52	48	49	52	41	48	119	47	46
30	---	---	80	51	47	48	39	40	49	118	49	45
31	---	---	74	---	51	---	34	36	---	e117	---	46

X denotes data not available from USGS; **---** denotes data not taken that day

Figure 28.
Gage Readings: USGS Station #09408135 (Above Quail Creek, Near Hurricane, Utah)

1991 Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	**NO DATA AVAILABLE FOR PERIOD JANUARY 1991--DECEMBER 1991 FOR THIS STATION**											
02												
03												
04												
05												
06												
07												
08												
09												
10												
11												
12												
13												
14												
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21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												

X denotes data not available from USGS; **---** denotes data not taken that day

Figure 28.
Gage Readings: USGS Station #09408135 (Above Quail Creek, Near Hurricane, Utah)

1992 Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	---	---	---	---	237	72	54	33	87	61	180	67
02	---	---	---	---	209	59	51	52	67	67	140	65
03	---	---	---	---	191	62	56	50	69	71	134	64
04	---	---	---	---	181	75	47	39	65	65	133	63
05	---	---	---	---	200	60	50	43	64	76	135	69
06	---	---	---	---	180	56	54	45	77	70	98	77
07	---	---	---	---	e200	46	56	86	76	65	154	72
08	---	---	---	---	140	46	61	78	67	64	140	83
09	---	---	---	295	138	51	59	74	66	66	---	79
10	---	---	---	299	112	53	64	65	43	62	---	75
11	---	---	---	287	80	53	73	67	51	76	149	71
12	---	---	---	320	78	55	59	102	67	---	---	96
13	---	---	---	e370	68	55	111	76	79	---	103	99
14	---	---	---	e390	62	55	123	62	78	58	129	70
15	---	---	---	378	55	55	72	56	67	58	102	---
16	---	---	---	311	50	55	70	67	115	61	113	88
17	---	---	---	256	46	54	64	57	68	84	110	73
18	---	---	---	e330	50	55	59	48	63	89	85	78
19	---	---	---	206	49	58	59	48	141	93	78	80
20	---	---	---	152	51	56	55	52	128	93	75	61
21	---	---	---	150	65	54	50	55	109	87	80	57
22	---	---	---	184	74	57	38	55	67	84	81	56
23	---	---	---	211	56	61	42	e750	66	75	94	59
24	---	---	---	185	98	60	42	e200	68	82	82	55
25	---	---	---	192	99	71	47	e120	54	116	75	39
26	---	---	---	216	97	70	48	89	60	107	68	31
27	---	---	---	244	105	61	52	57	69	73	91	28
28	---	---	---	246	208	62	51	48	80	79	92	115
29	---	---	---	254	119	58	44	42	71	102	94	76
30	---	---	---	243	385	57	37	48	54	184	84	139
31	---	---	---	---	e130	---	31	141	---	984	---	85

X denotes data not available from USGS; --- denotes data not taken that day

Figure 28.
Gage Readings: USGS Station #09408135 (Above Quail Creek, Near Hurricane, Utah)

1993 Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	52	287	329	**DATA AFTER MARCH 20, 1993 NOT ON HAND**								
02	52	182	274									
03	74	149	274									
04	48	123	269									
05	45	112	280									
06	53	97	---									
07	105	88	348									
08	1250	911	360									
09	378	1440	366									
10	195	492	372									
11	300	300	398									
12	127	196	394									
13	78	156	324									
14	500	133	325									
15	456	121	357									
16	521	111	405									
17	685	96	429									
18	944	98	590									
19	484	758	586									
20	267	---	499									
21	173	1450	---									
22	178	1030	---									
23	161	892	---									
24	125	832	---									
25	108	---	---									
26	104	---	---									
27	105	335	---									
28	109	390	---									
29	105	---	---									
30	95	---	---									
31	277	---	---									

X denotes data not available from USGS; **---** denotes data not taken that day

Figure 29.
Wilderness Study Areas: Virgin River Basin, Utah

Name	Acres Proposed:BLM	Acres Proposed: UWC
Beaver Dam Wash	0	24,900
Beartrap Canyon	40	40
Black Ridge	0	21,800
Canaan Mountain	33,800	52,100
Cottonwood Canyon	9,583	11,500
Cougar Canyon	6,408	10,000
Deep Creek	3,320	7,100
Doc's Pass	0	19,400
Goose Creek Canyon	89	89
Joshua Tree	0	13,500
LaVerkin Creek Canyon	567	567
Moquith Mountain	0	26,500
North Fork Virgin River	1,040	1,040
Orderville Canyon	1,750	6,500
Parunuweap Canyon	17,888	37,700
Red Butte	804	804
Red Mountain	12,842	18,500
Spring Creek Canyon	1,607	4,400
Taylor Creek Canyon	35	35
The Watchman	600	600

Figure 30.
Initial W&SR Eligibility Determinations: BLM Dixie Resource Area

Determined "eligible"

Beaver Dam Wash West Fork	Crystal Creek	Deep Creek
Doc's Pass Canyon	Upper Horse Valley Wash	LaVerkin Creek
Maxwell Canyon	Oak Creek/Kolob Creek	Second Creek
Sheep Canyon	Sheep Corral Canyon	Short Creek
Smith Creek	South Creek	Squirrel Canyon
Virgin River (St. George-to-Stateline)		Water Canyon

Determined to possess outstandingly remarkable values but not meet the "40% Rule"

Beartrap Canyon	Fort Pearce Wash	Goose Creek
Kolob Creek Narrows	Kolob Creek Upper	North Fork Virgin Narrows
North Creek	Pine Park Canyon	Quail Creek
Santa Clara River	Shunes Creek	
Virgin River (Springdale-to-St. George)		

Determined to not possess outstandingly remarkable values, but to meet the "40% Rule"

Beaver Dam Wash East Fork	Bull Canyon	Cottonwood Spring Wash
Cottonwood Wash	Grapevine Spring Wash	Jackson Spring Wash

Determined to not possess outstandingly remarkable values and to not meet the "40% Rule"

Ash Creek	Beaver Dam Wash Utah	Gould Wash
Lower Horse Valley Wash	Magotsu Creek	Moody Wash
Virgin River North Fork/Springdale		North Ash Creek

Determined to not be free-flowing

Bear Canyon	Big Spring	Bunker Peak Wash
City Creek	Cottonwood Creek	Cougar Canyon
Dry Creek	Grapevine Wash (West)	Graveyard Wash
Harrisburg Wash	Jackson Wash	Leeds Creek
Little Creek	Maxwell Canyon Left Fork	Mill Creek
Sand Cove Wash	Tobin Wash	O'Neal Gulch West
Willis Creek		

Figure 31.
Conservationists' Proposal: Areas of Critical Environmental Concern, Virgin River Basin

UTAH

AreaName	Resource Value(s)	BLM?	Map Locator
Red Bluff	T&E plant; Salinity control	Y	
Warner Ridge/Fort Pearce	T&E plant; Salinity control; Riparian resources; C2 animal	Y	K
Santa Clara River/Gunlock	Riparian resources; Cultural resources; Wildlife habitat; Spinedace habitat	Y	F
Santa Clara River/Land Hill	Riparian resources; Cultural resources; Wildlife habitat; Spinedace habitat	Y	G
Lower Virgin River	Riparian resources; T&E fish; Cultural resources; Wildlife habitat	Y	C
Little Creek Mountains	Cultural resources	Y	
Canaan Mountain	Scenic resources	Y	
Red Mountain	Scenic resources	Y	
Beaver Dam Slopes	Desert tortoise habitat	Y	
City Creek	Desert tortoise habitat; Community watershed; wildlife habitat	Y	
Upper Beaver Dam Wash	Watershed resources; Riparian resources; Wildlife population and habitat	Y	E
Cedar Pockets/Bulldog Pass	Cultural resources	N(1)	
Red Cliffs	Peregrine falcon habitat	N(2)	

Figure 31 (continued)

Pintura	Deer range	N(3)(4)	
Black Ridge	Scenic resources	N(3)(6)	
Beaver Dam Wash	Scenic resources; Wildlife habitat; Riparian resources	N(4)	D
Webb Hill	T&E plant	N(5)	
Shinob Kibe	T&E plant	N(5)	
Navajo Sandstone	Unique natural system	N(6)	
Hildale Springs	Watershed	N(6)	
Paradise Canyon	Desert tortoise habitat	N(7)	
Santa Clara Butte	T&E plant	N(?)	
Deep Creek	Scenic resources	N*	I
Virgin River North Fork	Scenic resources	N*	J
Kolob Creek	Scenic resources	N*	
Goose Creek	Scenic resources	N*	
Beartrap Canyon	Scenic resources	N*	
Willis Creek	Scenic resources	N*	
LaVerkin Creek	Scenic resources	N*	H
Taylor Creek	Scenic resources	N*	
Red Butte Creek	Scenic resources	N*	
Cave Valley	Scenic resources	N*	
Crater Hill	Scenic resources	N*	
Rockville Bench	Scenic resources	N*	
The Watchman	Scenic resources	N*	

Figure 31 (continued)

Shunesburg	Scenic resources	N*	
Gooseberry Mesa	Scenic resources	N*	
	ARIZONA		
Virgin River corridor	Riparian values; T&E fish; Scenic resources	Y	B
Beaver Dam Slopes	Desert tortoise habitat	Y	
	NEVADA		
Virgin River Archeological District	Cultural resources	Y	
Virgin River Corridor	Scenic resources; T&E fish; Wildlife habitat	Y	A

KEY

N(1) BLM expects region's resource(s) to be protected by a designated right-of-way that provides for mitigtion should damage occur at any site.

N(2) BLM expect no conflict between resource(s) and other uses in the area.

N(3) BLM determined that area resources do not meet relevance/importance criteria.

N(4) BLM plans to protect area resources via special stipulations on oil and gas leasing.

N(5) BLM determined that resources in this region are protected within ACEC designations in other regions.

N(6) BLM determined that resources in this region are protected via other special management designations.

N(7) BLM determined that it does not have sufficient jurisdiction to designate the region as an ACEC.

N(?) BLM does not address the potential for ACEC designation in this region.

Figure 31 (continued)

N* For scenic regions associated with Zion National Park, BLM determined that "no potential effects...from actions permitted by the RMP...would require expressed management prescriptions and the designation of scenic ACECs" [Dixie RMP, at 163].

Regions in **bold** are wilderness study areas under BLM and/or Congressional consideration. Public land resources in BLM WSAs receive protection under interim management guidelines. However, additional WSAs being considered as part of H.R. 1500 (Utah's BLM wilderness bill) do not receive that interim protection. Therefore, SUWA recommends that H.R. 1500 WSAs be designated ACECs until H.R. 1500 is enacted.

Regions underlined have been determined by BLM and/or SUWA to contain waterways *eligible* for wild and scenic river status. Waterways deemed eligible for W&SR status are likewise afforded interim protection until a decision regarding their suitability for designation is made. Areas not designated as wild and scenic should be immediately granted ACEC status.

Regions in **bold underline** are recommended by BLM and/or SUWA for wilderness designation and also are deemed eligible by one or both organizations for wild and scenic river designation.